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Beyond fragmentary: A proposed measure for travel vaccination concerns

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ABSTRACT

The travel medicine literature points to travelers' concerns as significant promoters of their under-vaccinations. Therefore, this study researches the hitherto understudied concept of vaccination concern and its theoretical scope in the international travel space. It attempts a conceptualization of the concept by delimiting its theoretical scope and proposes a measure for it. An exploratory sequential mixed-methods design was used to conduct four interlocking studies using data from a netnography, field interviews, and surveys among varied international travelers. A scale with six dimensions, comprising safety, efficacy, cost, time, access, and autonomy concerns were revealed. The scale significantly explained mainstream and segments-based tourists' uptake attitudes and behavior for their eligible vaccines. The findings suggest that anti-travel vax sentiments and public vax sentiments despite conceptually similar are considerably distinct. The broad nature of the scale and its prediction of travelers' vaccine uptake make it clinically relevant for tracking and resolving concerns for increased vaccine uptake.

1. Background

Immunization protects people, especially international travelers, against infectious diseases that may be encountered abroad and prevents the spread of these diseases between and within countries (WHO, 2013). Evidence indicates that immunization has significantly reduced the global burden of infectious diseases, disability, and death (WHO 2018; Centers for Disease Control, 2017). Despite the usefulness of vaccination, its sub-optimal uptake among international travel populations remains a significant public health challenge. Sub-optimal vaccination refers to delays, incomplete vaccinations, and refusal to take eligible vaccines (Bedford et al., 2017). Selcuk et al. (2016) report that about 45 percent of Turkish business travelers to Africa had not taken at least one of the recommended vaccines. Frew, McGeorge, Grant, and de Wildt (2016) also observed that 40 percent of 1680 backpackers who were visiting Thailand had sub-optimally vaccinated against hepatitis B. Sub-optimal vaccination undermines global vaccine coverage, breaks herd immunity and fosters disease outbreak and spread (Larson et al., 2016). Travelers without protection against vaccine-preventable diseases (VPDs) may get become sick when exposed. In the case of contagious diseases, they might facilitate the disease spread while traveling and upon returning home (Poulos, Curran, Anastassopoulou, & De Moerlooze, 2018). Based on data from the GeoSentinel Surveillance Network from 49 specialized travel/tropical medicine clinics on six continents, Boggild et al. (2010) reported various VPDs among 37,542 travelers who returned home. These ranged from enteric (typhoid and paratyphoid) fever, hepatitis, influenza, yellow fever, varicella, measles, pertussis to bacterial meningitis. After its outbreak in Wuhan, the 2019 coronavirus disease (COVID-19) is confirmed to have spread globally through international travelers.

Systematic reviews have shown that people's concerns towards vaccination are significant factors for under vaccination (Larson, Jarrett, Eckersberger, Smith, & Paterson, 2014). These concerns are varied and include vaccine safety and efficacy misconceptions, mistrust, lack of information, and faith compatibility issues (Karafillakis & Larson, 2017). The term 'vaccination concern' is used rather than 'vaccine concern' because people's apprehensions about immunization include not only vaccines but its related systems and actors. Travel medicine studies (Crockett & Keystone, 2005; Lammert et al., 2016) exploring reasons for the variable vaccine uptake among travelers have reported some concerns; however, they are piecemeal and patchy. Though these studies are helpful, the fragmented nature of the findings does little to

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explain the theoretical depth of the concept of travel vaccination concerns.

Behavioral scientists assert that individuals' perceptions about objects, including their concerns, are multifaceted. According to them, anti-vaccination attitudes, for instance, manifest in various dimensions, namely mistrust of vaccine, benefits, worries about unforeseen future effects, concerns about commercial profiteering, and preference for natural immunity (Martin & Petrie, 2017). It implies that to have a proper understanding of vaccination concerns (especially one that can inform behavioral intervention), a conceptually grounded approach to studying it is required. Currently, a psychometric measurement scale that can be used to assess vaccination attitudes and beliefs, including concerns among international travel populations is almost non-existing. Travel medicine studies on vaccination concerns have often conceptualized and measured the concept from a mono-dimensional perspective (Lammert et al., 2016). This implies that tourists' concerns about vaccination have mostly been looked at as mono indicators, not as multi-dimensional constructs. The investigation of vaccination concerns as a mono indicator, arguably, is not only conceptually narrow but may constrain an in-depth understanding of what constitutes travel vaccination concern, its antecedents, and outcomes. This situation risks weak clinical and theoretical usefulness of research findings on this subject.

There exist useful measures with undertones of vaccination concerns in the general vaccine literature, including the vaccine confidence scale (Gilkey et al., 2014), vaccine conspiracy belief scale (Shapiro, Holding, Perez, Amsel, & Rosberger, 2017), vaccine hesitancy scale (Larson et al., 2015; Shapiro et al., 2017) and anti-vax scale (Martin & Petrie, 2017). But beyond the children centered and allied nature of the measures, they are not travel context-specific and could be significantly problematic using them as proxies. The use of proxy theoretical measures and constructs is usual in all research domains, including vaccination studies. However, the challenge is estimating when the convergent validity of a [non-context] proxy is significant enough to permit one measure to substitute for another in research design. Convergent validity is the extent to which measures address a universal construct. Proxy measures that offer less-than-perfect convergent validity obscure and results in inconsistent findings and policy recommendations (Carlson & Herdman, 2012).

Larson et al. (2014) posit that vaccination concerns are dynamic and context-specific and should be studied accordingly. International travel is unique in context to ordinary life (Chen, Bao, & Huang, 2014). We propose that the characterization of travel vaccination concerns may be unique, relative to those measures developed for everyday life settings or children immunization. International tourism involves a movement away from one's home across national and international boundaries over some time and defined by discretionary time and income. This and, perhaps, among other reasons, suggest that the concerns of tourists about travel vaccination would be different from everyday vaccination concerns as international travel could present peculiar situations.

The current study focuses on an essential but ignored phenomenon in tourism and public health research - vaccination for international travel. The study fills the void of no existing measure for travel vaccination concerns by conceptualizing the concept of travel vaccination concern and proposes a scale that measures it. It aims to consolidate the bits of measures in the literature through a critical synthesis and analysis of previous findings, online text mining, field interviews, and surveys to propose a psychometric scale for travel vaccination concerns (referred to as TRAVAC scale). The aim to develop this scale suggests that a successful development would be of great value for international tourism research. It offers an understanding of what it means to be concerned about travel vaccination and provides insights on its limits and specific dimensions as a psychometric concept. This is done by following the best practices proposed by behaviorists (Churchill, 1979; Shapiro et al., 2017; Wen, Meng, Ying, Qi, & Lockyer, 2018) for scale development and validation. The development of a travel context-specific measure is desirable for use in surveying travelers' vaccination concerns. A right scale provides conceptual clarity and a more theoretically informed basis for gauging travel vaccination sentiments, their influence on vaccination uptake. It also allows for the comparison of findings across personal characteristics, contexts, and over time.

On the practical usefulness of the scale, its facets could aid public health practitioners, travel medicine professionals in particular, to target and tailor interventions for addressing specific anti-travel vaccination concerns among their clients. Targeted and tailored interventions are both deemed not only practical and persuasive in addressing audience-specific concerns when compared to generic messages, but useful for addressing health inequities because they engage individuals' values, beliefs and identity structures (Padela, Malik, Vu, Quinn, & Peek, 2018). Therefore, we are of the view that anti-travel vaccination sentiments should be studied independently of general anti-vaccination attitudes to better understand and proffer context recommendations for managing them. Drawing inferences from public vaccination contexts for the design of interventions to deal with travel-specific vaccination sentiments could result in a poor match of solution for the problem, making the spread of VPDs through international travelers unabated.

2. Literature review

2.1. Risk perception in tourism–emphasis on perceived health risk

Broadly, the literature classifies tourism risk into absolute and perceived. Absolute risk denotes an objective assessment of potential hazards and the magnitude of their consequences. In contrast, perceived risk is the subjective estimation of the hazard and its consequences (Adam, 2015). In this view, absolute risk does not vary from person to person, but the subjective risk does. A noticeable trend is that the debate surrounding the usage of the terms risk and uncertainty. Risk and uncertainty apply primarily to all touristic circumstances and encounters. Two debatable perspectives have surrounded the use of the terms risk and uncertainty. The first side of the debate views risk and uncertainty as related concepts that often have cliques used them interchangeably. For them, risk is viewed as an individual's unfavorable feeling of uncertainty about the outcome and consequence of an action (Dayour, Park, & Kimbu, 2019). According to this school of thought, every consumption decision has an inherent risk, which manifests in two interrelated forms of uncertainties. First is uncertainty about the decision, and the second is the uncertainty about the consequence of the action.

The second side of the debate argues for a distinction between risk and uncertainty, albeit most researchers combine both terms in their studies yet do not often indicate the differences between the two concepts. However, Williams and Baláž (2014) offer some differentiation between risk and uncertainty. They define risk as probably known possibilities, while uncertainty denotes unknown possibilities. With uncertainty, there is partial knowledge or no known probabilities of the outcome and severity of the perceived harm. It is a situation in which anything can happen and one has little or no idea as to what it is or what it will be. It is characterized by a lack of surety or indeterminacy of future outcomes as either positive or negative. In contrast, with risk, some measure of likelihood can be assigned to the possible adverse outcome (An, Lee, & Noh, 2010).

Nevertheless, common among the concepts is that both draw attention to some inherent loss in a choice situation. This accord, however, only highlights the negative connotation of risk and uncertainty, which can be misleading and limiting. People have ignored the risk and uncertainty associated with decisions and ultimately derived benefit from them (Hillen, Gutheil, Strout, Smets, & Han, 2017). The second unanimity is that risk and uncertainty are multi-dimensional in occurrence, meaning that people can associate different levels of risk nand uncertainity with the same event implying a varied conception of potential losses. Finally, both affect current and future decisions and outcomes.

The literature recognizes that the travel and tourism industry is vulnerable to various hazards with inherent risks and uncertainties.

Natural disasters, terrorist attacks, financial crises, and the outbreak of diseases are some of these hazards (Hajibaba, Gretzel, Leisch, & Dolnicar, 2015; Quintal, Lee, & Soutar, 2010). Risk and tourism are, therefore, inseparable. Unlike the other dangers, tourists' vulnerability to health risks is on the high side, irrespective of the destination (Chien, Sharifpour, Ritchie, & Watson, 2017). It is projected that about 30–50% of travelers return home ill or injured (Wang, Liu-Lastres, Ritchie, & Mills, 2019). Tourism-related health risks comprise infectious and non-infectious diseases, accidents, injuries, impairments, and even death (Pratt, Tolkach, & Kirillova, 2019). HIV and AIDS, Zika, Ebola, SARS, swine flu (HINI) and Coronavirus (COVID-19) are some examples of diseases tourists are susceptible to depending on the travel destination. Others include typhoid, hepatitis A and B, influenza, rabies, yellow fever, polio, meningitis and malaria. The emergence and re-emergence of these diseases, in part, are attributed to overseas travel (Aubry et al., 2012).

The intersection between international travel and the risk of diseases is due to the inexorable increasing scale of international tourism (UNWTO, 2020), differences in environmental conditions (i.e., weather conditions, water, sanitation and hygiene [WASH]) between countries, and tourists' attitudes and behaviors (Jonas, Mansfeld, Paz, & Potasman, 2011). For example, tourism spaces offer suitable environments for people to engage in sexually risky behavior (especially casual sex), making those involved vulnerable to sexually transmitted infections (Omondi & Ryan, 2017). Strangely, the majority of previous studies conclude that perceived health risk is ranked low among travelers (Frew et al., 2016; Jonas et al., 2011; Lammert et al., 2016; Wang et al., 2019). The low credence given by tourists to health risk is due to their apparent high vulnerability to other hazards such as crime relative to health risks (Jonas et al., 2011). Other writes argue that the usual health risks faced by tourists tend not to be life-threatening (Huang, Dai, & Xu, 2020; Page, 2009). We think that the evidence on the actual health risks encountered by tourists (especially VPDs), their ripple effects, and associated costs when compared to other hazards is deficient, which accounts for why tourists downplay health risks. Dioko and Harrill (2019) affirm that aggregate statistics on travelers who return home sick, fatalities of tourism-related deaths, and disability are scarce.

Nevertheless, inferring from the few available statistics, it is obvious that the micro and macro-economic burden of health risks are enormous. Significant drops in destination arrivals and business traffic such as passenger traffic, attraction visitation numbers, and hotel occupancy are some of the adverse impacts of disease outbreaks. For instance, the SARs of 2003 reduced tourism arrivals by 0.4% in 2003 (UNWTO, 2020). The current COVID-19 pandemic, has so far accounted for over 18 million infections, and 600,000 deaths worldwide. Its impacts on economies have equally been devastating, and the tourism and the hospitality sector is currently one of the most affected sectors with international tourist arrivals likely to decline between 20 and 30%, valued between US$300–450 billion. Firms ceased to operate; others curtailed their operations to a portion of their capacity, and millions of employees have lost their jobs (UNWTO, 2020; Worldometer, 2020).

There are variations in visitors' perceived risk of specific diseases and across destinations. From a list of 50 countries, respondents rated Canada, New Zealand, Switzerland, Sweden, and Australia as the five safest countries (Sönmez & Graefe, 1998). On the other hand, Iraq, Somalia, Libya, Lebanon, and Syria were identified as the five riskiest countries to visit. Asia and North America were considered to be more hazardous in terms of the frequency and severity of natural disasters. Africa, South America, the Middle East, and Asia are risky for infectious diseases (Kozak, Crotts, & Law, 2007). In a rating of destination health risks, destination induced hazards (water quality, health care quality, food safety, disease infection) were ranked high. Semi-controlled hazards (physical injury, the safety of extreme adventure facilities, environmental, physical conditions) were rated as moderate health hazards, and fully controlled hazards (sexually transmitted diseases and drug and drug abuse) were the least ranked. While water quality and food safety have the inherent perceived risk of VPDs, tourists' under-estimation of their likelihood of disease infection and sexually transmitted diseases are attributed to they having greater control over such hazards (Jonas et al., 2011). Perceived greater control over health risks perhaps is born out of their lack of information on the full spectrum of actual vulnerability and severity, and complacency.

Similarly, previous studies have underscored that risk perceptions vary by travelers' socio-demographic, psychographic, and trip characteristics. However, research on how perceived health risk varies by these characteristics are inadequate when compared to studies on other risk domains. Understanding how risk perceptions vary by group differences can help with tailored communication to modify risk perceptions (Deng & Ritchie, 2018). Kozak et al. (2007) observed that tourists from China, Singapore, and Malaysia were more concerned about infectious diseases, terrorist attacks, and natural disasters when compared to others. Simpson and Siguaw (2008) noted that Mexican tourists were more worried about health and wellbeing and destination environment. Gender, length of stay, trip motivation, the purpose of visit, and travel experience are some underlying reasons for the observed variations. Young independent, curious, adventurous, and rural-based travelers, such as backpackers, are less concerned about travel risk, health risk in particular when compared to mass tourists. Males also perceive less risk when compared to females (Lepp & Gibson, 2003).

Backpackers generally have a high tolerance for risk when compared to other normative tourists. But there are a limited number of dedicated studies on their travel health risks. The few studies concluded that their most significant concerns when traveling abroad are zoonotic diseases, sexually transmitted diseases (STIs), and hygiene issues (Hunter-Jones, Jeffs, & Smith, 2008; Dahlman & Stafström, 2013; Adam, 2015; Badu-Baiden, Boakye, & Otoo, 2016). Marked differences, however, exist based on gender, country of origin, and other demographic characteristics. Backpackers' vulnerabilities to these health risks are due to their explorative and drifter lifestyle, abusive alcohol and drug use, and patronage of sub-standard accommodation facilities (Steffen & Connor, 2005). Regarding their perceived VPDs, Frew et al. (2016) reported that the majority of their sampled backpackers in Thailand considered themselves vulnerable to hepatitis B, albeit about 44% differed. For UK backpackers to Africa, the majority are worried about contracting yellow fever, rabies, and dengue fever, but only a third perceived themselves prone to contracting meningitis and thus vaccinated (Goodman, Masuet-Aumatell, Halbert, & Zuckerman, 2014). The literature also considers people visiting friends and relatives (VFR), those with preexisting medical conditions, and those who are immunocompromised as at-risk populations. Immunocompromised travelers are more vulnerable to infections due to their immune system's deficits and their chance of attenuating responses to vaccines. For instance, the risk of diseases is higher among travelers living with HIV, asplenia, cancer, diabetes, cardiopulmonary diseases, and inflammatory disease than those without preexisting medical conditions (Dekkiche, de Vallière, D'Acremont, & Genton, 2016).

2.2. Travel vaccines, vaccination, and immunization

Travel to different places can expose one to diseases and their associated consequences. Thus, it necessitates immunization, which is the uptake of a vaccine against a disease pathogen(s) before traveling to an endemic destination. A vaccine is a biological preparation administered into a person's body to elicit an immune response(s) against the disease (s) for which the vaccine is intended. "A vaccine typically contains an agent that resembles a disease-causing microorganism, such as viruses or bacteria, and is often made from weakened or killed forms of the microbe, toxins, or surface proteins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and remember it so that the immune system can easily recognize and destroy any of these microorganisms that it later encounters" (WHO 2018:1). Vaccines sometimes contain preservatives or antibiotics to preserve the

vaccine or adjuvants to stimulate an immune response. Vaccines are administered either through needle injections, by mouth, or by aerosol. Drawing from the preceding WHO's the definition of a vaccine, we consider travel vaccination as an attempt to expose the body of a traveler to a vaccine – weakened or killed form of the pathogen that causes illness – such as viruses or bacteria – or its toxins or one of its surface proteins. The vaccine induces acquired immunity so that when the individual's body encounters the real disease-causing agent, it is ready to mount a defense.

Beyond the individual level, vaccines create herd immunity. Herd immunity is especially crucial for safeguarding individuals at risk, including infants and immune-compromised persons who cannot be vaccinated due to age or medical reasons. However, the trepidation about herd immunity is the 'free rider' problem, where some people intentionally choose not to vaccinate with the intent of benefiting from those who are immune (Yaqub, Castle-Clarke, Sevdalis, & Chataway, 2014). Stern and Markel (2005) view that despite vaccination and immunization often being used interchangeably in practice, the latter is a more inclusive term, which refers to the development of adequate immunity to a disease as a result of the administration of a vaccine.

Specific to travel, there are three classes of vaccines, namely routine, required, and recommended vaccines (WHO, 2013). Routine vaccines are recommended at specific periods for everyone and are usually part of most national immunization programs. Examples of routine vaccines are hepatitis A and B, rotavirus, DTaP, tetanus, pneumococcal, HPV, flu, polio, and meningococcal. Most adults in some countries have received all their routine vaccines as children, which has significantly provided herd immunity to populations in those countries to diseases prevented by routine vaccines. However, international travelers must be up-to-date with routine vaccines because under-vaccination rates are still prevalent in some countries (Centers for Disease Control, 2017; WHO, 2017). Required immunizations are mandatory vaccines travelers are expected to take before entering designated destinations based on international health regulations. For example, yellow fever vaccination is necessary for travelers of over nine months of age arriving or in transit of at least 12 h through countries at risk to Ghana; and meningococcal and polio are required for pilgrims to Saudi Arabia. Unlike required vaccines, recommended vaccines are not mandatory. They are often suggested to international tourists based on disease risk endemicity, meaning that the disease is significantly present in the location of travel (Crockett & Keystone, 2005).

2.3. The concept and potential facets of vaccination concern

The literature provides evidence that people have concerns about vaccination. Vaccination concern has often been studied using related terms such as risk and uncertainty, worry, anxiety, fear, constraints, and morality (see Karafillakis & Larson, 2017; Larson, Paterson, & Erondu, 2012). Discerning vaccination concerns through its related concepts mentioned above are understandable because it may be difficult to observe it directly. What matters is to operationally distinguish between these terms and use them in specific ways, but this appears not to be the case in the current vaccine literature. Some studies have used these concern-related terms interchangeably without providing their conceptual differences, which may not only result in theoretical inconsistencies but limit the comparison of research findings. For instance, Karafillakis and Larson (2017) make no differentiation between the terms 'risk' and 'uncertainty,' 'fear,' 'worry' and 'anxiety' using them interchangeably in their study, which is quite problematic. Research in psychology indicates that despite their similarities and relationships, they have subtle differences, which must be recognized (Fennell, 2017). We stick to the term vaccination concern and operationalize it as apprehensions that people hold about travel vaccination, which are either perceptual, real or a combination of these, potentially limiting them from embracing vaccines wholeheartedly. These concerns can be cognitive or emotional or combined. We elect that those who vaccinate and those who refuse vaccines can be concerned about certain aspects of travel vaccination (Yaqub et al., 2014).

Previous research mentions various facets of travel vaccination concerns, some of which are related to vaccines, vaccination-related institutions, and the involved individuals themselves. Though piecemeal across the multiple studies, the most common concerns include safety, efficacy, cost, access, and time (Crockett & Keystone, 2005; Steffen & Conner; Lammert et al., 2016). Different longitudinal and systematic review studies among tourists and the general population across different vaccines and countries have noted that vaccine safety and efficacy concerns are the most reported (Crockett & Keystone, 2005; Karafillakis & Larson, 2017). Vaccine safety concern is the feeling that travel vaccination results or will result in harmful outcomes and efficacy concern is the fear that vaccines do not or will not perform as desired or expected (Yaqub et al., 2014). Vaccine safety and efficacy issues running through the findings of these travel and non-travel context studies imply that these concerns are prevalent across travel and non-travel settings and different vaccines. The prominence of such matters is due to people's general perception that the risks of vaccination outweigh their benefits (Karafillakis & Larson, 2017).

Specific types of concerns about vaccine safety and efficacy are, however, identified for the different studies. For instance, Crockett and Keystone (2005) realized that travelers' vaccine safety and efficacy concerns manifest in the form of fear of side effects of vaccination, mistrust of vaccine efficacy, and fear of the pain of injection. Among Hajj pilgrims, previous studies have found that doubts regarding vaccine effectiveness are a critical reason that accounts for their low uptake of the influenza vaccine (Bish, Yardley, Nicoll, & Michie, 2011). Karafillakis and Larson's (2017) synthesis of human vaccine studies between 2004 and 2014, on the other hand, noted perceived low effectiveness of vaccines, lack of evidence of the effectiveness of vaccines and injection pain as significant concerns. The perception that vaccines cause the disease they prevent and worry about vaccine adjuvants are also noted. Anti-vaccine activists, for instance, claim that ingredients, such as mercury, ether, antifreeze, formaldehyde, and aborted fetal tissues contained in vaccines, are toxic (Kata, 2012).

Other safety and efficacy concerns border on fear, anxieties, and related adverse events that accompany vaccines' uptake. The fear of vaccination is a feeling of nervousness induced by perceived danger. On the other hand, anxiety is a manifestation of fear in response to the anticipation or experience of taking a vaccine. Evidence exists that a significant number of people are anxious during pre-travel consultations about injection before actual vaccination. In Noble, Farquharson, O'Dwyer, and Behrens' (2013) study sample of 105 people from London, they estimated the prevalence of injection anxiety to be more than 39 percent. A systematic review by Loharikar et al. (2018) identified fainting, dizziness, palpitations, giddiness, headache, hyperventilation, and weakness as some anxiety-related symptoms following immunization (Loharikar et al., 2018). Implicated vaccines included tetanus, diphtheria, hepatitis B, oral cholera, human papillomavirus, and influenza A (H1N1). Fear of needles, injection injury, and anecdotes of being sick of the disease(s) vaccinated against have also been reported in the literature (Nir, Paz, Sabo, & Potasman, 2003).

The literature further highlights the cost and time involved in travel vaccination as major concerns (Gautret, Tantawichien, Hai, & Piyaphanee, 2011; Goodman et al., 2014; Poulos et al., 2018; Wang et al., 2019). These two factors reflect affordability concerns, which are the inability of individuals to afford travel vaccination, both in terms of financial and non-financial costs (Thomson, Robinson, & Vallée-Tourangeau, 2016). The financial concerns relate to income scarcity while the non-financial relates to time scarcity, which are both socially patterned resource barriers to health (Thomson et al., 2016). Scarcity is the relative feeling of having less than is desirable to satisfy one's needs determined by comparing one's disposable resource, time and income, to the demands placed on it (Venn & Strazdins, 2017). Time constraints become an issue whenever multiple doses of a vaccine are

required (Steffen & Connor, 2005).

Travel vaccinees, mainly backpackers and volunteer tourists, have often lamented that vaccination services are expensive, time-wasting, and inconveniencing. Barasheed et al. 's. (2014) study among Australian Hajj pilgrims and that of Goodman's (2014) among UK travelers to meningitis belts in Africa identified financial and time constraints as the underlying reasons for those who refused influenza and meningococcal vaccine respectively. The refusers indicated that they were too busy to get the vaccine; likewise, the vaccines were too expensive. A discrete choice experiment study by Poulos et al. (2018) report a significant inverse association between cost and German travelers' vaccine uptake and their preference decisions. Those traveling for volunteerism and backpacking purposes were more likely to under-vaccinate than those traveling for business and visiting friends and relatives (VFR). In addition to Australian travelers to Southeast Asian destinations perception that the rabies vaccine comes with side effects, they reported that (1) the rabies vaccination is scarce in travel clinics; (2) the vaccination is expensive; (3) obtaining rabies vaccine (multiple intakes) is time-consuming; and (4) GP service only provides generic health consultations, not specific for travel-related health consultation (Wang et al., 2019).

Using data from the Global TravEpiNet, though Lammert et a. (2016) observed that cost and time were rarely cited as an underlying reason for the refusal of the studied (influenza, meningococcal, typhoid, hepatitis A, tetanus, polio, rabies, yellow fever and Japanese encephalitis) vaccines among international travelers, except for Japanese encephalitis and influenza. Similar findings have been recounted by Duffy, Weintraub, Vellozzi, and DeStefano (2014) in a survey among US travelers to Asia. None of these studies, however, pointed out why the Japanese encephalitis is considered expensive. However, the reason could be gleaned from Karafillakis and Larson's (2017) assertion that the vaccine is difficult to produce and needed in multiple doses with several boosters for long-term protection.

Vaccination cost and time concerns mirror access concerns. Diverse interpretations exist to the concept of access, and researchers have acknowledged the lack of unanimity in describing and measuring health access (Dassah, Aldersey, McColl, & Davison, 2018). Some have studied access as the availability of health services (Donabedian, 1973); entry into a health care system (Andersen, 1995) and recently Dassah et al. (2018) consider it as the availability and use of health services rather than the mere presence of the services, suggesting realized access and not potential access. Therefore, access in the context of vaccination relates to the ability of individuals to quickly reach and/or to be reached by recommended vaccines. "The degree to which individuals know the need for, and availability of, recommended vaccines and their objective benefits and risks" is referred to as awareness (Thomson et al., 2016, p. 1019). This factor reinforces the importance of cues to action in determining vaccination decisions, with optimal awareness positively motivating vaccine uptake. Awareness factors include the availability of information, knowledge of vaccines, and vaccination schedule. Unfortunately, issues of vaccine information deficit (including not knowing where to locate appropriate vaccines), information overload, conflict messages, and misunderstanding of available information are reported in the literature (Karafillakis & Larson, 2017). Admittedly, with the proliferation of conflicting information on the internet, it has become challenging to communicate vaccine information while engendering trust effectively (Makarovs & Achterberg, 2017).

Some researchers have argued that it is not vaccines per se that are mistrusted; instead, vaccination institutions (Yaqub et al., 2014). In that case, trust for the institutions involved in the manufacture and delivery of vaccines is as crucial as the vaccines themselves. Literature notes that mistrust and decreasing confidence in vaccines and vaccination-related institutions among the general public remain pronounced. In their critical review, they (Yaqub et al., 2014) realized that distrust of doctors, government, and pharmaceutical companies' is the reason for hesitancy and outright refusal of vaccination. Trust is an individual's attitude based on personal beliefs about the features of another (Mayer, Davis, & Schoorman, 1995); therefore, people may behave in a certain way while assuming others will react by their expectations. However, if others do not act according to their expectations, it results in mistrust. Vaccination trust concerns have hardly been investigated among travelers, but among the general population, studies have observed that the general public does not trust vaccines and their related institutions. They have often lamented that vaccination is a money-making venture for pharmaceuticals. Likewise, researchers churn out findings that only highlight the benefits of vaccines while ignoring safety issues (Ehrenstein et al., 2010).

Autonomy implies the capability to make informed decisions devoid of interference and force. It is about owned decisions backed by free will and personal reflection. Autonomy is often interpreted and situated with moral, political, and ethical stances. While one may be tempted to equate freedom to making decisions that inure to only one's benefit, Kantian is of the view that autonomy is about rational choices. Rational decisions (though bounded) mean decisions that are self-owned but empathetic to others' well-being, which suggests a sense of moral accountability with rewards: praise or blame (Kirkland, 2016a). However, there are limits to autonomy, for example, based on gender, ability, and power dynamics, making autonomy partial or quasi. This understanding of freedom among people has led to contestations, hesitancy, and sometimes refusals of vaccines. These oppositions are rooted in the interpretation of vaccination mandate policies, rules, and regulations as lacking liberalism and naturalism. Vaccination mandates, mass campaigns, limited exemptions, penalties refusing vaccines are some aspects of vaccinations contested (Attwell & Smith, 2018). Table 1 presents a summarized list of the potential dimensions and their definitions.

2.4. Relationship between concerns and travel vaccination

People respond in varied ways towards vaccination, depending on their concerns. These responses are either cognitive, emotional, or behavioral, and their valence could be positive, negative, or a combination and may co-occur (Hillen et al., 2017). The Strategic Advisory Group of Experts (SAGE) considers individuals' responses towards vaccine uptake as a continuum, oscillating between complete refusals of vaccines to outright acceptance and maybe context, time, population, and vaccine-specific (WHO, 2013). Acceptance denotes the act of consenting to vaccination without any reservations. It involves the adoption and endorsement of vaccination to other people.

On the other hand, refusal refers to a complete rejection of vaccination (MacDonald, 2015). The SAGE identifies two forms, each for acceptance and refusal of vaccination, which are indicators of heterogeneities in peoples' reactions toward immunization. These are an outright refusal of some or all vaccines and outright acceptance of some or all vaccines (WHO, 2013). In between vaccine refusal and acceptance is a third strand known as vaccine hesitancy. The term vaccine hesitancy is characterized by a lack of conceptual clarity, which is attributed to the attempt to use hesitation to explain all partial or non-vaccination as well as a lack of a clear distinction in its determinants (Bedford et al., 2017). The widely cited definition of vaccination hesitancy is by SAGE: "a delay in acceptance or refusal of vaccine despite the availability of vaccine services" (WHO, 2013).

Previous studies (including Steffen & Connor, 2005; Crockett & Keystone, 2005; Lammert et al., 2016; Wang et al., 2019) have concluded that vaccine concerns reduce travelers' willingness to vaccinate. Nevertheless, most of the studies that have tried to analyze the effect of concerns on vaccine uptake have hardly measured the latter as a rate. Vaccine uptake rate is a measure of coverage that seeks to understand the proportion of vaccines taken by an individual out of the number recommended (WHO, 2017). Uptake rate is also crucial for appreciating the extent to which individuals' concerns can undermine their acceptance of vaccination or otherwise. An appraisal of the impact of specific concerns on vaccine uptake shows disparate and

Table 1
Potential constructs of the travel vaccination concern scale drawn from the literature and qualitative data.

Dimension	Dimension definition	Relevant literature
Mistrust/lack of confidence concerns	Skeptical or doubtful of vaccines and/or its related stakeholders, including vaccinators, pharmaceuticals and policymakers.	Steffen and Connor (2005); Yaqub et al. (2014); Larson et al. (2016) Karafillakis and Larson (2017);
Safety concerns	Feeling that travel vaccination results or will result in harm or injurious outcomes	Steffen and Connor (2005); Thomson et al. (2016); Becker et al. (2016); Yaqub et al. (2014), Alfelali et al. (2018); Lindsey, Rabe, Miller, Fischer, and Staples (2016); Noble, Farquharson, O'dwyer and Behrens (2013); Loharikar et al. (2018)
Efficacy/ performance concerns	Concerned that vaccines do not or will not perform as desired or expected.	Steffen and Connor (2005); Karafillakis and Larson (2017); Yaqub et al. (2014)
Cost/financial concerns	Concerned with the financial burden associated with accessing travel vaccination.	Steffen and Connor (2005); Crockett and Keystone (2005); Boggild et al. (2010); Blank et al. (2012); Thomson et al. (2016); Wang et al. (2019)
Time concerns	Vaccination would result in waste of time or loss of time convenience	Crockett and Keystone (2005); Poulos et al. (2018); Thomson et al. (2016);
Access concerns	The difficulty or inability to access needed travel vaccines.	Steffen and Connor (2005); Yaqub et al. (2014); Crockett and Keystone (2005);
Information concerns	Lack of/inadequate and/or conflicting information on travel vaccination	Karafillakis and Larson (2017); Rossen, Hurlstone, Dunlop, and Lawrence (2019)
Vaccine literacy concerns	Inability to optimally obtain, process, understand and make an informed vaccination decision	Karafillakis and Larson (2017)
Autonomy concern	Feeling that vaccination and its related policies are limiting one's liberty, autonomy and/or freedom	Dubov and Phung (2015); Attwell and Smith (2018); Rossen et al. (2019)

contradictory findings. Regarding safety and efficacy concerns and vaccine uptake, Crockett and Keystone (2005) concluded that the more concerned travelers are with these, the higher their likelihood of refusing vaccines. The study identified a lack of confidence in vaccines' efficacy, the perceived unsafety of vaccines, adverse effects, injection anxiety, and cost as significant reasons for sub-optimal vaccination. Among Hajj pilgrims, previous studies found that doubts regarding vaccine effectiveness are an essential reason that accounts for their low uptake of the influenza vaccine (Bish et al., 2011).

Cost and time concerns have also been reported as limiting factors of vaccination adoption (Gautret et al., 2011; Goodman et al., 2014; Poulos et al., 2018). Cost especially is a significant constraint to the uptake of vaccines among international travelers, because out-of-pocket expenditure is higher for travel-related vaccines than for routine immunizations. A discrete choice experiment study by Poulos et al. (2018) report a significant inverse association between cost and German travelers' vaccine uptake and their preference decisions. However, those traveling for volunteerism and backpacking purposes under-vaccinated more than those who did for business and to visit friends and relatives (VFR). A similar finding on cost concerns undermining vaccine uptake has been reported by Gautret et al. (2011) among backpackers though notable differences were realized across the country of origin. Among Australian Hajj pilgrims and UK travelers to meningitis belts in Africa, Barasheed et al. (2014) and Goodman (2014) identified financial and time constraints as the causal reasons for those who refused the vaccines, respectively. The refusers indicated that they were too busy to get the vaccine before traveling. Likewise, they considered the vaccines too expensive. Lammert et al. (2016), on the other hand, observed that cost and time were rarely cited as an underlying reason for the refusal of the vaccines they studied except for the Japanese encephalitis vaccine. Similar findings have been recounted by Duffy et al. (2014) in a survey among US travelers to Asia. None of these studies, however, pointed out why the Japanese encephalitis vaccine is considered expensive. However, the reason could be gleaned from Karafillakis and Larson's (2017) assertion that the vaccine is difficult to produce and needed in multiple doses with several boosters for long-term protection. The next section of the study discusses the methodology used for empirically formulating and testing the TRAVAC scale.

3. Material, methods, and results

3.1. Research design

An exploratory quantitative-dominant (QUAN + qual) sequential mixed methods design incorporating qualitative and quantitative data collection and analysis were employed (Johnson & Onwuegbuzie, 2004). This was because the study had to go through the process of developing a new survey measurement instrument and validating it as a scale. A multi-stage recursive psychometric procedure proposed by Churchill (1979) for developing and validating scales was adopted. The process involved four studies of five stages: item generation, item purification, evaluation of the latent structure, testing the nomological and predictive validity of the measurement scale, and scale replication. Previous studies have widely used this procedure (e.g., Chen et al., 2014; Larsen, Brun, & Øgaard, 2009; Wen et al., 2018) across various disciplines. Fig. 1 illustrates the research design and how the integration of methods was done in the study. The details of each of the stages and the results are described in the subsequent paragraphs.

3.2. Methods and results for study 1-qualitative study

3.2.1. Stage 1: item generation and purification

The item generation process consisted of two independent steps: literature review and qualitative data gathering and analyses. The search strategies used in the item generation were to ensure a comprehensive and broad reach of travel vaccination concerns. The generation of the items was guided by the principle of saturation (a situation where new significant views ceased to emerge) (Guest, Bunce, & Johnson, 2006; Mason, 2010).

3.2.1.1. Systematic literature review. The first stage commenced with an extensive review of related studies to gather the initial pool of potential measure items. The widely applied Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) framework was adapted to guide the systematic review (Fig. 2) and measurement item identification. Concepts related to travel vaccination and concerns and existing vaccination attitude scales were reviewed. The documents reviewed included peer-reviewed articles and books retrieved from databases across Scopus, Medline, Web of Science, PubMed, and Open Grey. Notably, most of the vaccine-based reviewed articles were drawn from the following journals: Vaccine, Travel Medicine and Infectious Diseases, and Social Science and Medicine. Worth noting is that most mainstream tourism journals have hardly had travel vaccination-related articles in their databases. A document was reviewed if it studied vaccination/vaccine concerns, risk and or uncertainty, safety, mistrust, beliefs, among other related terms. Aside from animal-related studies, searches were not restricted by population, context, and type of vaccine. The inclusion of a document was decided by a careful review of the

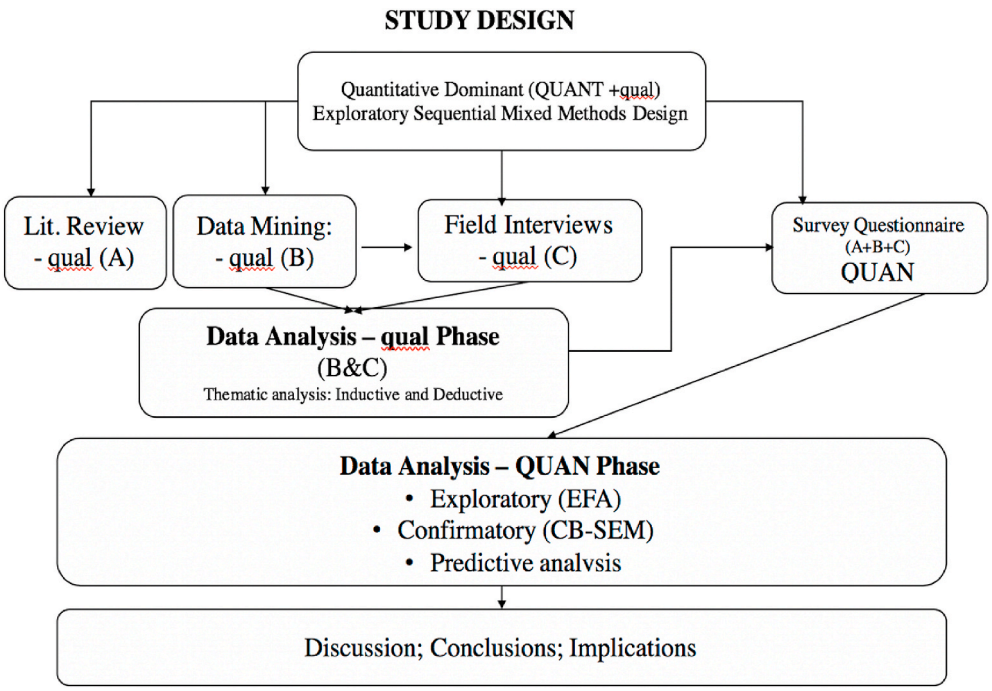

Fig. 1. Research design for the study Source: Adapted from Churchill et al., (1979); Johnson and Onwuegbuzie (2004) and Dayour et al. (2019). Note: QUANT stands for Quantitative and qual stands for Qualitative, and upper case shows where emphasis lay.

abstract or executive summary. Identified items were extracted into a table created in Microsoft Excel, with one column for the identified issue and another for the source of the text extracted. Each row in the spreadsheet represented a single item. This resulted in an initial pool of 36 items after removing duplicates.

3.2.1.2. Netnograhy. The first stage in the qualitative data collection involved unsolicited online text/sentiment mining from the Vaccine Sentimeter via HealthMap. The text mining was meant to draw global anti-travel vaccination sentiments to corroborate, enrich, and reduce the bias associated with field-based qualitative data (Powell et al., 2016). The Vaccine Sentimeter is the most extensive dedicated online automated media monitoring system which tracks, gleans, and analyses real-time global conversations about vaccination. It aggregates and archives data from 100,000+ online sources ranging from social media (i.e., Facebook, Twitter), news aggregators, blogs (i.e., TripAdvisor), eyewitness reports, expert-curated discussions to validated official reports (Vaccine Sentimeter 2018). Though the HealthMap dashboard currently hosts only comments between June 2012 and September 2014, up-to-date data were requested via info@epidemico.com. The platform has been used by several researchers (including Larson et al., 2014; Larson et al., 2016; Powell et al., 2016), and its usefulness and reliability for tracking global vaccine concerns confirmed. Based on a text processing algorithm, HealthMap automatically assigns a title, date, source, Uniform Resource Locator (URL), plain text content, location(s), and disease to each report. The search was adapted mainly to focus on only reports relating to anti-travel vaccination sentiments about human vaccines.

The URL of the story was followed for further reading. Most of the travel vaccination sentiments were found in TripAdvisor, the largest online platform hosting trip reviews (Litvin, Goldsmith, & Pan, 2018). Others were extracted from segment-based (such as backpackers and volunteer tourist) travel blogs. Similar to the literature review, the search terms included a combination of Boolean terms such as travel immunization or vaccination, and concerns, perceptions, worries, doubts, risks, uncertainties, safety concerns and sentiments. The extraction included all forms of comments without time or language restriction, but all non-English comments were translated into English using Google Translate (Larson et al., 2016). In total, 1235 online posts were extracted.

3.2.1.3. Field qualitative interviews. After the approval of the study protocol by the Institutional Review Board (IRB) of the University of Cape Coast, we commenced the second stage of the field-based qualitative data collection. In-depth interviews (IDI) with 20 inbound tourists were conducted using an IDI guide. The guide was made up of three sections. Section A addressed questions on the demographic characteristics of the interview participants, including their sex, educational status, and country of residence. Section B addressed their general views about VPDs and international travel, and section C focused on questions that elicited their travel vaccination concerns. The IDI guide maintained flexibility and openness so that interviews were adapted to situations. The guide's content validity was reviewed by the second and third authors of the study and an additional faculty member with expertise in qualitative research. The assessment was meant for them to assess the extent to which the questions measure what they intended to. Subsequently, the guide was pre-tested among three (3) international students who visited the University of Cape Coast in August 2016 for exchange programs. The assessment led to additions of probes where necessary.

The actual field interviews, facilitated by the Lead Author, were conducted between April and June 2017 in Cape Coast. The participants were purposively sampled and approached using a broad and heterogeneous approach. A purposive sampling of varied groups (considering their region of residence: Europe, Africa, America, etc.; and sex: males and females) was done. This approach helped to elicit varied opinions on the subject under investigation. The interviews were intended to verify and beef-up the already generated items from the literature review and the netnography. Meetings were scheduled at the respondents' convenience, mostly in public areas of attraction sites, restaurants, and hotels and lasted for between 30 and 50 min. Verbal consent was sought from each respondent before the interview. None of the respondents declined participation and recording of the discussions. The characteristics of the respondents are found in Table 2.

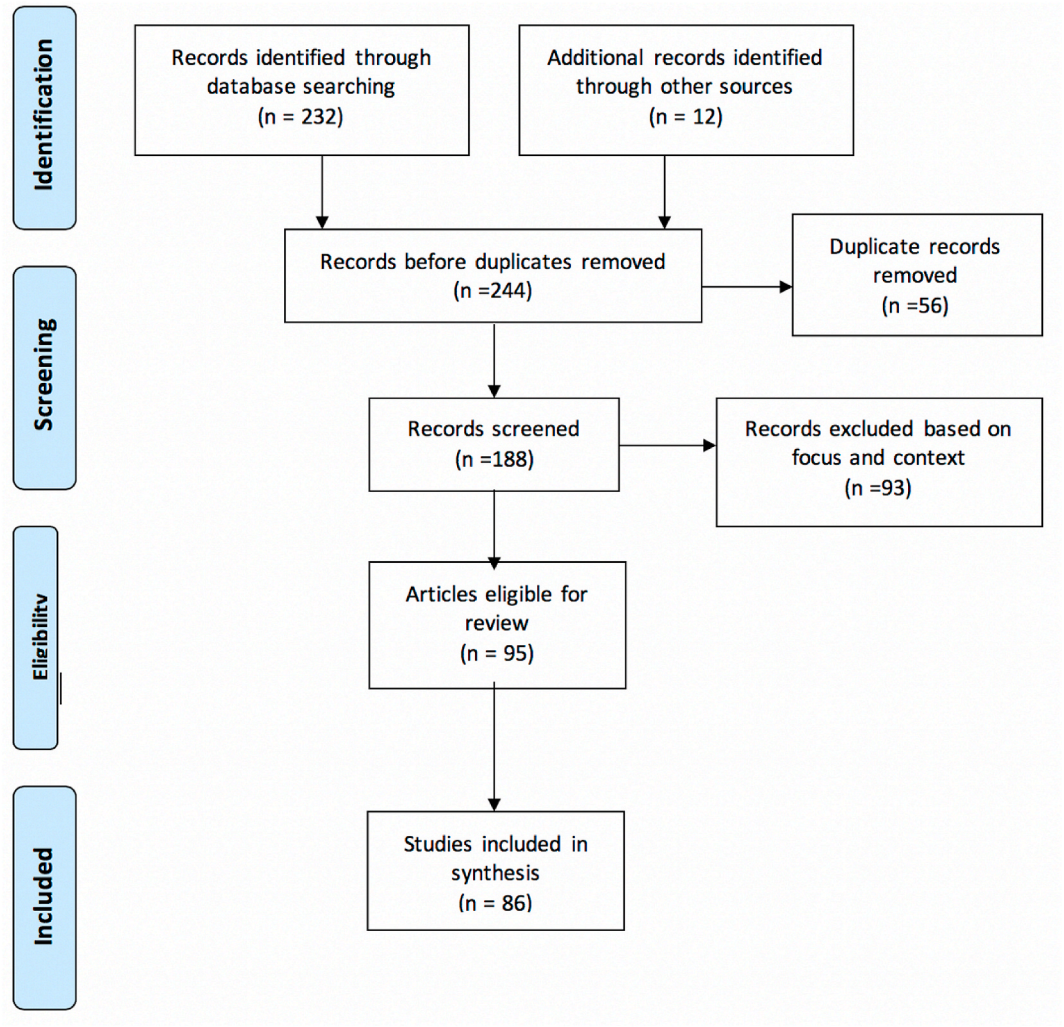

Fig. 2. Adapted PRISMA 2009 flow diagram for the travel vaccination concern literature review.

Table 2
Demographic characteristics of the interview sample.

Category	Interviewee	Gender	Age	Country of Origin
Pre-test				
	1	Male	26	Ivory Coast
	2	Female	25	USA
	3	Female	20	Spain
Main study				
	4	Male	37	Belgium
	5	Female	60	Sweden
	6	Male	50	Germany
	7	Female	41	USA
	8	Male	29	Netherlands
	9	Male	22	UK
	10	Male	30	Spain
	11	Female	32	Canada
	12	Male	25	France
	13	Female	32	South Africa
	14	Female	30	Togo
	15	Female	27	Liberia
	16	Male	43	USA
	17	Male	43	Germany
	18	Female	21	Germany
	19	Male	45	Nigeria
	20	Female	28	Hong Kong
	21	Female	33	Czech Republic
	22	Male	19	Austria
	23	Male	52	UK

3.2.1.4. Data analysis and results. Regarding the online comments, the names of those to whom statements were directed were removed from the dataset; likewise, all HTML tags. However, all image files, mainly meme images, were retained. Meme image text was retained for analysis because they indicated the severity and varying opinions of negative comments in the language people chose to use when discussing vaccination sentiments. The field interview data, on the other hand, was transcribed verbatim by listening to the tapes. The Lead Author and one field assistant independently coded the transcripts to enhance the validity of the findings. The resultant transcripts were then read one after the other the second time, along with listening to their corresponding audio to ensure that the interviewees' responses were transcribed accurately. Both transcribers verified and resolved inconsistencies in codes. Summaries of text from the netnography and field interviews were analyzed in NVIVO 12 using both inductive and deductive reasoning.

Since the qualitative data were meant to draw out additional measurement items for the TRAVAC scale, the data processing began with the researchers independently gleaning and summarizing the negative sentiments about travel vaccination (Table 3).

This was done by inspecting the most mentioned negative Boolean terms about vaccination in the word cloud and tree. The drawing of the items was done by ignoring the theory of the initial items gotten from the literature. Comparison and integration were made with the items derived earlier during the grouping stage. It is crucial to first "ignore the literature of theory and fact on the area under study, to assure that the

Table 3
Major themes of travel vaccination concerns and illustrative quotations (qualitative results).

Theme	Illustrative quotations	Gender	Source	Link
Efficacy	…It made me wonder how wholly necessary many travel vaccinations are, to begin with.	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/#my-experiences
	I trust science, but I don't think science truly knows how interconnected our body is, so how can it really know the bad effects vaccines will have on me when I am abroad.	Male	Field Interview	
	I am just a bit wary of putting things like vaccines in mind-body when traveling.	Female	Field Interview	
	The thought of being injected [with] microbes in my veins while traveling to a foreign country [scares me]	Female	Field Interview	
	I don't think vaccines must be taken all the time, especially when traveling.	Male	Field Interview	
	I seriously doubt that receiving a travel vaccine is the best way to stay healthy when basic holiday sanitation should be enough.	Male	Field Interview	
	… I'm just going to come out and say it: I personally don't believe in getting vaccinated to the hilt before traveling.	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/
	I'm not a conspiracy theorist, but neither will I dismiss the idea that not all travel vaccinations are recommended with our best intentions as the first priority	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/
	Not enough evidence of vaccination effectiveness	Male	Field Interview	
Safety				
	I am afraid of the side effects of vaccines. I got flu and headaches from the yellow fever vaccine I took.	Male	Field Interview	
	Unfortunately, our family does not do well with vaccines … I took shots before an Egypt trip and ended up with Hashimotos Thyroiditis and cancer within 2 years.	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/
	The last time I took jabs when I was traveling I had redness and swelling at the injection site.	Male	Field Interview	
	Omg, I can't even deal. I hate needles and shots more than anything	Female	Online	https://www.neverendingfootsteps.com/vaccinations-and-long-term-travel/
	I had to have five different injections all in one go before I went to Vietnam last year. Not ideal, but at least it got it all out of the way, and some of them will last for about 10 years now, so phew.	Female	Online	https://www.neverendingfootsteps.com/vaccinations-and-long-term-travel/
	I am afraid of their effects on my body when abroad.	Male	Field Interview	
	Some travel vaccines bring me allergies.	Female	Field Interview	
	My typhoid shot was the most painful I've ever had in my life! Way worse than tetanus. I couldn't move my arm for two days! [Reply] @Michelle, Ouch! My arm was sore about three days after the tetanus shot, so I can't imagine getting a typhoid one. Glad I stuck to the pills.	Female	Online	https://sightdoing.net/travel-vaccines-cost/
	We had sore arms the first night after our shots; it was difficult to avoid bumping each other on the couch. It was also challenging trying to avoid lying on the affected arms while falling asleep. The next day we woke up with flu-like symptoms, and our arms were much sorer. I could barely lift my coffee cup without feeling pain. It wasn't terrible, however, and the flu symptoms were nothing like the real flu	Female	Online	https://inspiringtravellers.com/expensive-arm-jabs-travel-vaccinations-pre-travel-health/
	The side effects of malaria medication alone are not easy, let alone several jabs.	Male	Field Interview	
	The vaccine might conflict with other medications I have taken.	Female	Field Interview	
	I just think that vaccines are not good for one when traveling.	Female	Field Interview	
	I don't believe we fully understand the residual effects heavy metals and synthetic preservatives have on the cellular system.	Male	Field Interview	
Cost	The rabies vaccination is expensive and requires multiple shots, and apparently, you have about 72 h to receive treatment.	Female	Online	https://inspiringtravellers.com/expensive-arm-jabs-travel-vaccinations-pre-travel-health/
	We are planning a trip to Peru (including a place in the Amazon basin), and I have been very put off by the expense of the yellow fever inoculation (as high as $250 I was told.	Male	Online	https://sightdoing.net/travel-vaccines-cost/
	Is expensive [to take travel vaccines], especially yellow fever.	Male	Online	https://www.tripadvisor.com/ShowTopic-g294206-i9216-k7236817 How_Much_Should_Vaccines_Cost_for_Kenya-Kenya.html
	I had to fork out for a few last years not available on NHS, so I ended up spending an extra 150 pounds on meds and vaccines. Pain in the ass literary.	Male	Field Interview	
	Travel vaccines are a way of making money by health organizations.	Male	Field Interview	
	They are costly and usually not covered by insurance.			
	Some years back, I forked out about 400pounds or something ridiculous for some vaccines at a private clinic.	Male	Field Interview	
	I think we travelers are just a means through big pharma, and travel clinics make money. They don't care about our health.	Female	Field Interview	

(*continued on next page*)

Table 3 (*continued*)

Theme	Illustrative quotations	Gender	Source	Link
	I can't believe how cheap rabies shot is over there. It's prohibitively expensive here in California. Like close to $1000 for the series! I think we'll wait until we get that shot for cheaper abroad.	Male	Online	https://www.neverendingfootsteps.com/vaccinations-and-long-term-travel/
	Everything about travel vaccination is costly. It is especially worrying that they charge for every consultation you make on those vaccines.	Female	Field Interview	
	Travel vaccinations are a money-grab strategy for health professionals as they use various fear-mongering tactics about travel.	Male	Field Interview	
	…I'm hoping that for my upcoming RTW, I'll only need to fork out for malaria tabs and the Enchepalitis one! Fingers crossed because otherwise, it can take a chunk out of your budget!	Female	Online	https://www.neverendingfootsteps.com/vaccinations-and-long-term-travel/
	-Doctors are but salespeople of travel vaccines. I have experienced a lot more doctors trying to tote and defend their programming than make people better.	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/
Time	It is inconveniencing because the clinics are located farther away, and you have to travel over distances	Female	Field Interview	
	It is bothering and time wasting trying to access travel vaccines. Also, even if they are available, some of the shorts are staggered and often require that you repeat your visit to the facility.	Male	Field Interview	
	Too busy to get the vaccine.	Male	Field Interview	
	The fact that you have to take them early enough is worrying.	Female	Field Interview	
Access				
	Sometimes the stock of travel vaccines becomes limited.	Female	Field Interview	
	You can't get everything [vaccination] done in one place.	Male	Field Interview	
	My clinic doesn't stock all these medications, so I have to go to multiple clinics.	Female	Field Interview	
	When I took off to travel full-time, I didn't know all the places I'd visit (I still don't) where to get all vaccines.	Male	Field Interview	
	No reliable information on where to find your needed travel vaccines.	Male	Field Interview	
Autonomy				
	Why do I have to be forced to get the vaccine just because I am going on holiday?	Male	Field Interview	
	I think people should have a right to say yes or no to mandatory travel vaccines.	Male	Field Interview	
	I am not happy to be forced to take some vaccines.	Female	Field Interview	
	Nono, sorry I did vaccinate for yellow fever, as it is an obligation. However, this is not fair as I just did not want to put any substance into my body while traveling [abroad].	Male	Field Interview	
	Sometimes you travel for a few weeks holiday yet you are legally required to take some vaccines, come on this not fair.	Male	Field Interview	
	- … why the push for vaccinations only if we travel?	Female	Online	https://www.theprofessionalhobo.com/travel-vaccinations-yes-or-no/

emergence of categories will not be contaminated by concepts more suited to different areas" (Glaser & Strauss, 1967, p. 37). By combining the items, a total of 53 items were identified. The questions were then re-worded with the help of the topic words/phrases (Table 4) to match the context of travel vaccination.

3.2.2. Stage 2: item purification

The second stage comprised expert review and exploratory factor analysis of the measurement items to purify the pool of questions. The details of these processes are explained in this section.

3.2.2.1. Expert review. The list of draft items was subjected to a specialist review to evaluate the items' face and content validity. The experts were asked to indicate yes or no, with an appropriate comment where necessary, on the clarity, readability, suitability, representativeness, and redundancy of each item. The experts included two academics with expertise in travel vaccine studies and scale development; two members of the Strategic Advisory Group of Experts (SAGE) on immunization and two travel medicine professionals. SAGE is the primary advisory group to WHO on vaccines and immunization. Based on the review results of the experts, some of the items were removed, others combined while others were revised of their verbiage. Any of these

Table 4
Topic labels and topic words/phrases from netnography and field interviews.

Topic Label	Top words/phrases
Mistrust/lack of confidence	mistrust, wary, doubt, disbelief, skeptical, wonder, suspicious
Safety	Unsafe, synthetic, preservatives, microbes, hurried, harmful, conflict
Cost	Costly, expensive, money-grab, ridiculous cost, several charges
Side effects	Flu, headaches, allergies, scared, afraid, redness, swelling, painful, nervous, anxious, scary, hurting, numerous/several jabs
Efficacy	No enough evidence, ineffective, lack of confidence
Time	Farther location of vaccine clinics involve travel over distances, time bothering, time wasting, too busy, time inconveniencing, early uptake is worrying
Stockout	Stockout of vaccines becomes limited, can't get everything at one place, don't know where to get vaccines
Mandates	Why the push for vaccinations only if we travel? Force, not fair, no choice

actions were taken based on unanimity between the inputs of two or more judges. The 53 initial pool of items was trimmed to 45 and retained for the survey questionnaire. The questionnaire was designed and administered in the English language since most inbound tourists to Ghana read and write in English.

3.3. Methods and results for study 2-quantitative study

3.3.1. Stage 3: dimensionality determination of the measurement scale

3.3.1.1. Data collection instrument and procedure. This stage comprised the collection of survey data to explore the dimensional structure of the TRAVAC scale. This stage also doubled as a pre-test of the survey questionnaire. The data were collected from 300 inbound tourists to Ghana between September and December 2017, using a convenience sampling technique, but 250 questionnaires were found useful for analysis. The respondents were approached conveniently at the visitor waiting area of the most visited attractions (i.e., the Kakum National Park, the Cape Coast Castle, and Elmina Castle) while they were waiting to receive on-site orientations or during check-out of the facility. For those who visited the attractions in groups, two people on average were chosen to participate in the study. This approach guarded against potential group bias (Adongo, Taale, & Adam, 2018). Those who provided consent were given a questionnaire each to fill out and return it to the field assistant before checking out the facility.

The survey was structured into four sections (Sections A to D). Section A contained a filter question, which sought to determine whether the individual had been interviewed on the same subject in the other attraction sites to prevent duplicate respondents. This section also contained questions on their vaccination uptake behavior. A checklist of vaccines that tourists to Ghana are expected to be up-to-date on was provided to the respondents to self-report by indicating those vaccines they had fully or partially taken or not taken at all. The list of vaccines was adapted from WHO's (2018) list of recommended vaccines for travelers to Ghana. These are routine vaccines (MMR vaccine, diphtheria-tetanus-pertussis (DTP) vaccine, varicella vaccine, and polio vaccine), mandatory vaccines (yellow fever vaccine), and recommended vaccines (hepatitis A, hepatitis B, typhoid, meningitis, and rabies). The respondents' vaccination history was captured using the self-reported method and could have some bias, but this was minimized by cross-checking with their vaccination cards. It is important to note that most of them had their immunization history digitally stored (i.e., via CDC's TravelWell App, e-mail, and online hospital folders), which was easy to retrieve. Others also had their history stored in both paper and digital versions. The elicitation method used for determining their vaccination status is similar to that employed by the WHO (2012) and Lammert et al. (2016) for collecting immunization data.

Section B measured their views on travel vaccination concerns on a rating scale of 0–10, where 0 meant not concerned at all and ten represented highly concerned. Questioning for specific vaccines, respondents were asked to indicate and rate their concerns using the measurement items presented to them. Perceptions and attitudes vary with different vaccines; for instance, hep B vaccine is not the same as yellow fever vaccine (Karafillakis & Larson, 2017). Section C of the survey elicited data on their responses toward vaccination, including perceived benefits of vaccines, hesitancy toward vaccination and whether they would recommend vaccines to others. These were also gauged using the ranking scale of 0–10. The measurement items in section B were drawn from Study 1. Section D measured respondents' socio-demographic and travel characteristics. Both respondents who ever vaccinated against a disease and those who ever under-vaccinated were sampled to minimize bias in the views.

3.3.1.2. Data analysis and results. The data were first presented using descriptive statistics to offer an understanding of the characteristics of the sample. About 58 percent of the exploratory sample were female. The majority were those who had never married (70.83%). However, a slightly higher proportion of males (32.19%) than females (29.0%) were married. The average age of the respondents was 28 years. Overall, the respondents sampled had some formal education [High school (33.75); Bachelor (38.33%) and Post-graduate (27.92%)]. The majority were Christian (65.35%), employed (76.42%) and had ever traveled abroad (84.62%). The average number of past trips among the respondents was 12. Detailed characteristics of the respondents are found in Table 5.

An Exploratory Factor Analysis (EFA) was used to explore the dimensional structure of the measure and remove poorly fitting items. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy ($\geq$0.80) and Bartlett's Test of Sphericity ($\chi 2 = 3868.12$; $P < 0.001$) showed that the 250 observations were suitable for EFA. The rotation method used was Promax employing the maximum likelihood method. This is because this rotational method is in sync with the rotational method used in covariance-based confirmatory factor analysis (CFA), the analytical technique used to confirm the explored dimensions in the third study. Eigenvalue greater than 1 was the criteria used for determining the number of factors extracted. The additional rule was that each dimension must have at least three items. A $\geq$0.5 loading on a primary factor, a communality of $\geq$0.6 and non-cross loading on any other factor at $\geq$0.40 was the threshold for retaining an item under a dimension (Hair, Black, Babin, & Anderson, 2010). The questions were repeatedly iterated until a clean pattern matrix was obtained (Byrne,

Table 5
Background characteristics of the exploratory and validation samples.

Characteristics	Exploratory sample (n = 250)	Confirmatory sample (n = 905)
	%	%
Sex		
Male	42.23	45.36
Female	57.77	56.64
Mean age	27.87	30.13
Marital status		
Married	29.16	30.17
Never married	70.83	69.83
Education		
High School	33.75	28.84
Bachelor	38.33	40.11
Postgraduate	27.92	31.05
Religion		
Christianity	65.35	56.02
Atheism	19.74	19.56
Agnostic	11.40	2.09
Islam	2.63	22.33
Others	0.88	–
Region of origin		
South-East Asia	2.19	0.77
Africa	10.00	7.85
Europe	66.88	70.83
America	17.80	17.02
Western Pacific	3.13	3.53
Employment status		
Employed	76.42	74.81
Unemployed	21.83	22.32
Retired	1.75	2.87
Past international travel experience		*(n = 452)*
First-timers	15.38	8.40
Repeaters	84.62	91.60
Average (mean) length of stay	16 days	23 days
Purpose of visit		
Leisure/recreation		27.76
Education/research		19.51
Volunteerism		34.84
Visiting friends and relatives		9.99
Business		7.90

Note: Other sample characteristics available based on request.

2010). A total of 18 items were dropped for having item-to-dimension loadings less than 0.50 and or inter-dimension cross-loading greater than 0.5. In all, six (6) unique dimensions, with 27 well fitted underlying items were extracted from the EFA, which explained approximately 76 percent of the variance in travelers' vaccination concerns. The Cronbach's alpha score for each factor was higher than 0.70, suggesting a satisfactory inter-item-dimension convergent validity (Hair et al., 2010). Given the exploratory nature of the first stage of the analysis, the factors were tentatively labeled Dimension 1, Dimension 2, through to Dimension 6. Details of the percentage of variance explained by each dimension and corresponding Eigenvalue are presented in Table 6.

3.4. Methods and results for study 3-quantitative study

3.4.1. Stage 4- validation of the draft measure: confirmation of the latent structure

3.4.1.1. Data collection. The second set of 905 completed questionnaires out of 1032 was used to confirm and refine the structural validity of the six-factor solution extracted in the EFA, using CFA in AMOS. The 905 respondents, if estimated based on the six latent constructs and 28 observed variables; an estimated statistical power of 0.95 and a Hoelter's statistic of 0.01 probability levels and a non-response rate of 10% using G-Power (Adongo et al., 2018), was a satisfactorily conservative sample size for the analysis. As a rule of thumb, the literature suggests that at the very least, a regression factor should correspond to 10 sample cases (Byrne, 2010). This means that a minimum of 220 responses is deemed adequate for performing the proposed analysis. The data collection procedure in Study 3 was similar to that for Study 2 described earlier, except that the data were disproportionately (50%:50%) collected from Ghana and online. This means that the methodology for the survey data in Ghana was the same as Study 2, narrated in section 3.3.1.1. But additional variables of interest (Appendix A) and a pre-travel travel-sample were included. The characteristics of the validation sample were similar to those of Study 2 (Table 5).

Given that pre-travelers are an unknown population and difficult to recruit, snowball sampling was used to collect data from them. We distributed the message to participate in the survey, including the link to the online designed questionnaire to a complied email list of initially identified people who were planning their trips abroad for the year, mainly to Africa and Asia. Following that, they were asked to forward the invitation to friends and relatives (Park & Stangl, 2020). Collecting part of the validation data online was meant to minimize the biases that characterize data from the same destination. Data from pre-travelers were also included at the validation stage to reduce the bias that may portray views drawn from people who were already traveling. People's opinions about vaccination are likely to be different before, during, and after the event.

3.4.1.2. Data analysis. The 905 observations were randomly divided into two sub-samples: comprising a calibration (n = 452) and validation sample (n = 453) using STATA 15 draw a sample technique. Similar sample splitting approaches have been used by previous scale development studies (Chen et al., 2014; Kim, Ritchie, & McCormick, 2012). Descriptive scores of the measures for the univariate skewness and kurtosis showed that the ratings are within tolerable thresholds of −/+1 (Table 7), and suitable for the co-variance-based CFA.

The CFA was used to confirm and refine (where necessary) the structural validity of the factor solution extracted from the EFA. The technique was selected over the alternative component-based CFA for three main reasons. The main reason is that the data were normally distributed. Covariance-based statistical techniques are parametric in nature and are appropriate when the data is normally distributed, while component-based methods are suitable for use when the data are not normally distributed (Byrne, 2010). Another reason was that the

Table 6
Results of the exploratory factor analysis (n = 250).

	Observed variables	EFL	EV	%VE	α
I	*Dimension 1*		6.86	28.03	0.87
	I do not trust vaccines to protect me from diseases while traveling abroad effectively	0.81			
	I am not confident in vaccines helping me stay healthy while abroad	0.73			
	Multiple uptakes of travel vaccines for different diseases can prevent my body from naturally fighting against diseases	0.63			
	I worry about the long-term effects of travel vaccines on my health	0.57			
II	*Dimension 2*		1.43	20.40	0.79
	I am not sure of the safety of vaccines for travelers	0.78			
	I worry about the side effects of travel vaccines	0.72			
	Taking vaccines when traveling abroad makes me feel uncomfortable	0.68			
	I fear the injection when taking travel vaccines because of the pains.	0.68			
	I worry that the side effects of vaccines while abroad can decrease my enjoyment of the holiday experience	0.59			
	I fear that I may not readily get medical assistance if experiencing the side effects of vaccines while abroad	0.53			
III	*Dimension 3*		1.09	9.38	0.74
	Travel vaccines are expensive	0.82			
	Taking vaccines during travel abroad increases the cost of travel	0.82			
	Consultations with health professionals on travel vaccinations cost much money	0.62			
	Travel vaccines are a means through which health care providers make money from travelers	0.73			
	Travel vaccines are a means through which pharmaceuticals make money from travelers	0.73			
	Dimension 4		1.06	7.75	
III	Travel vaccination can be time inconveniencing	0.79			
	Consultation with health care providers concerning travel vaccination can be time wasting	0.83			
	I am concerned that most travel vaccines have to be taken at least two months (early enough) before the actual travel.	0.82			
	The number of doses required for some travel vaccines delays travel time	0.79			
IV	*Dimension 5*		1.03	5.75	0.72
	It is often difficult to find all vaccines in one clinic	0.76			
	No reliable information on where to find all needed travel vaccines	0.74			
	Sometimes travel clinics ran out of some vaccines	0.76			
	Not aware one has to take certain vaccines	0.75			
V	*Dimension 6*		1.01	4.78	0.78
	Travel is a means through which certain vaccines are forced on travelers	0.85			
	Travelers are not given the right/freedom to refuse certain vaccines	0.85			
	Making certain vaccines mandatory is unfair to travelers	0.79			
	A trip is sometimes cancelled/delayed because you cannot get access to a mandatory vaccine	0.72			
	Total Variance Explained			76.09	

Note: EFL: Exploratory factor loading; EV: Eigenvalue, VE: Variance extracted; α: Cronbach's alpha.
KMO = 0.870, Bartlett's Test of Sphericity (Approx. χ^2) = 3868.12, $p = 0.000$.

Table 7
Descriptive statistics of measurement items of the TRAVAC scale (N = 905).

	Dimensions and underlying items	Parameters			
		M	SD	Skewness	Kurtosis
I	*Efficacy concern*	*2.22*	*1.60*	*0.79*	*−0.07*
	I do not trust vaccines to protect me from diseases while traveling abroad effectively	1.89	0.94	1.04	0.74
	I am not confident in vaccines helping me stay healthy while abroad	1.95	1.06	1.08	0.41
	Multiple uptakes of travel vaccines for different diseases can prevent my body from naturally fighting against diseases	2.28	1.14	0.48	−0.84
	I worry about the long-term effects of travel vaccines on my health	2.37	3.27	0.56	−0.58
II	*Safety concern*	*2.19*	*2.16*	*0.52*	*−0.52*
	I am not sure of the safety of vaccines for travelers	2.04	1.02	0.72	−0.25
	I worry about the side effects of travel vaccines	3.33	2.45	0.45	−0.54
	Taking vaccines when traveling abroad makes me feel uncomfortable	1.71	3.04	0.88	−0.03
	I fear the injection when taking travel vaccines because of the pains.	1.39	2.80	0.50	−0.58
	I worry that the side effects of vaccines (if any) while abroad can decrease my enjoyment of the holiday experience	2.93	3.33	0.61	−0.74
	I fear that I may not readily get medical assistance when experiencing the side effects of vaccines while abroad	1.76	3.04	−0.06	−0.96
III	*Cost concern*	*5.19*	*3.54*	*−0.16*	*−0.65*
	Travel vaccines are expensive	6.44	3.54	−0.78	−0.35
	Taking vaccines during travel abroad increases the cost of travel	6.43	3.56	−0.79	−0.36
	Consultations with health professionals on travel vaccinations cost much money	4.94	3.78	−0.24	−1.02
	Travel vaccines are a means through which health care providers make money from travelers	2.56	3.37	0.51	−0.75
	Travel vaccines are a means through which pharmaceuticals make money from travelers	5.56	3.47	0.51	−0.75
	Time concern	*2.93*	*3.39*	*0.59*	*−0.33*
III	Consultation with health care providers concerning travel vaccination can be time wasting	2.56	3.40	0.62	−0.57
	I am concerned that most travel vaccines have to be taken at least two months (early enough) before the actual travel.	4.27	3.70	−0.11	−1.13
	The number of doses required for some travel vaccines delays travels time	2.49	3.13	0.54	−0.70
	Travel vaccination can be time wasting as it is often difficult to find all vaccines in one clinic	2.39	3.33	1.32	1.08
	Access concern	*6.02*	*3.42*	*−0.78*	*1.12*
	It is often difficult to find all vaccines in one clinic	6.81	3.42	−1.23	1.12
	No reliable information on where to find all needed travel vaccines	6.83	3.06	−1.48	1.02
	Sometimes travel clinics ran out some vaccines	5.84	3.94	0.10	1.13
	Not aware one has to take certain vaccines	4.62	3.24	−0.49	1.22
IV	*Autonomy concern*	*4.17*	*3.27*	*−0.53*	*1.04*
	International travel is a means through vaccines are forced on people	4.67	3.52	−0.58	1.06
	Travelers are not given the right/ freedom to refuse certain vaccines	3.67	3.02	−0.51	1.06
	Making certain vaccines mandatory is unfair to travelers	4.67	3.51	−0.50	1.00
	A trip is sometimes cancelled/ delayed because you cannot get access to a mandatory vaccine	4.17	3.27	−0.50	1.02

Scale: 0-to-10.

confirmatory data for this study was 905 cases, one which exceeded the recommended sample size threshold for the use of component-based CFA as it risks convergence validity and improper factor solutions (Byrne, Lam, & Fielding, 2008). Component-based CFA works well with small sample sizes (less than 200 cases) source. The last reason was that covariance-based CFA is more robust and stringent for model validation, especially in the early stages of theory development, compared to component-based CFA (Byrne, 2010). The fitness of the model to the data was assessed using the goodness-of-fit index [GFI] (≥0.90), comparative fit index [CFI] (≥0.90), Tucker-Lewis index [TLI] (>0.95), and root mean square error of approximation [RMSEA] (<0.08) (Hair, Hult, Ringle, & Sarstedt, 2017; Hu & Bentler, 1999).

3.4.1.3. Results of the CFA. An initial attempt to fit the calibration model showed that the loadings scores of two items, one relating to 'dimension 1′ and the other 'dimension 2′, were lesser than 0.50; hence, modifications were conducted based on the indices. The change involved covarying two error terms of the involved items. Afterward, all measurement items had significant regression ($p < 0.001$) coefficients between 0.50 and 0.85 for both the calibration and validation models, which demonstrated unidimensionality across all dimensions. The composite reliability scores of the dimensions, as shown in Table 8, also ranged between 0.70 and 0.85, indicating adequate internal consistency in the measurement dimensions (Hair et al., 2010).

The overall model fit indices for both the calibration (CFI = 0.96, IFI = 0.96, TLI = 0.95, RMSEA = 0.04, NFI = 0.93) and validation models (CFI = 0.96, IFI = 0.95, TLI = 0.96, RMSEA = 0.03, NFI = 0.96) indicated that they were optimally fitted (Table 9).

Adequate discriminant validity is attained since each latent dimension shared more variance with its observed items than it did with other dimensions, as shown in Table 10 (Fornell & Larcker, 1981). Based on each dimension's content, they were labeled as efficacy, safety, cost, time, access, and autonomy concerns.

3.4.1.4. Stage 5–3.4.1.4. stage 5- Common method biases. Both pre and post techniques were employed to minimize and check for the presence of common method biases in the models (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First potential measures were subjected to expert querying to ensure clarity and avoidance of item social desirability, as mentioned earlier. Second, the study made use of several items, which were intermixed to minimize the consistency motif. Third, Harman's single factor test, where all items were constrained to load on one factor, was conducted during the EFA and CFA stages (Adongo et al., 2018). In the EFA, an unrotated factor solution was employed while in the CFA, a marker factor approach was used. Both estimations justified that a single factor did not sufficiently capture the covariance of the items and the percentage of variance explained in each case was 35% and 37%, respectively. With the measures adopted, it was envisaged that method bias was minimal and would not risk the conclusions drawn from the study.

3.4.1.5. Stage 6- structural invariance test. A structural invariance test was conducted to determine if the six dimensions of the TRAVAC scale vary across types of vaccines and different stages of travel, pre-travel and during the trip. This was to assess the representativeness and

Table 8
Results of the confirmatory factor analysis.

		Calibration sample (n = 452)			Validation sample (n = 453)		
		SDL	CR	AVE	SDL	CR	AVE
I	*Efficacy concern*		0.81	0.68		0.74	0.63
	I do not trust vaccines to protect me from diseases while traveling abroad effectively	0.73			0.74		
	I am not confident in vaccines helping me stay healthy while abroad	0.72			0.71		
	Multiple uptakes of travel vaccines for different diseases can prevent my body from naturally fighting against diseases	0.65			0.67		
	I worry about the long-term effects of travel vaccines on my health	0.72			0.73		
II	*Safety concern*		0.78	0.52		0.78	0.50
	I am not sure of the safety of vaccines for travelers	0.72			0.77		
	I worry about the side effects of travel vaccines	0.72			0.73		
	Taking vaccines when traveling abroad makes me feel uncomfortable	0.79			0.76		
	I fear the injection when taking travel vaccines because of the pains.	0.50			0.50		
	I worry that the side effects of vaccines (if any) while abroad can decrease my enjoyment of the holiday experience	0.76			0.75		
	I fear that I may not readily get medical assistance when experiencing side effects of vaccines while abroad	0.56			0.57		
III	*Cost concern*		0.79	0.50		0.85	0.66
	Travel vaccines are expensive	0.70			0.84		
	Taking vaccines during travel abroad increases the cost of travel	0.70			0.83		
	Consultations with health professionals on travel vaccinations cost much money	0.85			0.85		
	Travel vaccines are a means through which health care providers make money from travelers	0.68			0.75		
	Travel vaccines are a means through which pharmaceuticals make money from travelers	0.68					
	Time concern		0.81	0.51		0.78	0.50
IV	Consultation with health care providers concerning travel vaccination can be time wasting	0.62			0.75		
	I am concerned that I have to take vaccines early enough before I can travel abroad	0.50			0.76		
	The number of doses required for some travel vaccines delays travel time	0.60			0.60		
	Travel vaccination can be time wasting as it is often difficult to find all vaccines in one clinic	0.75			0.84		
	Access concern		0.73	0.56		0.74	0.52
	It is often difficult to find all vaccines in one clinic	0.70			0.73		
	No reliable information on where to find all needed travel vaccines	0.69			0.67		
	Sometimes travel clinics ran out some vaccines	0.73			0.74		
	Not aware one has to take certain vaccines	0.71			0.73		
V	*Autonomy concern*		0.70	0.50		0.70	0.50
	Travel is a means through which vaccines are forced on us	0.79			0.80		
	Travelers are not given the right/freedom to refuse certain vaccines	0.69			0.67		
	Mandatory travel vaccines are unfair to travelers	0.79			0.72		
	A trip is sometimes canceled/delayed because you cannot get access to a mandatory vaccine	0.73					

Note: SDL: standardized loading; CR = Composite Reliability; Average Variance Extracted.

Table 9
Post-estimation fit indices of models analyzed.

Type of model	GFI	CFI	TLI	IFI	NFI	RMSEA
The first order calibration model	0.94	0.96	0.96	0.95	0.93	0.05
The first order validation model	0.93	0.96	0.96	0.95	0.96	0.03
The second order calibration model	0.94	0.97	0.97	0.91	0.92	0.04
The second order validation model	0.92	0.96	0.94	0.96	0.94	0.02

Note: GFI = Goodness of Fit Index; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; IFI= Incremental Fit Index; NFI = Normed Fit Index; RMSEA = Root Mean Error of Approximation.

generalizability of the scale across various vaccines. The results showed that both constrained and unconstrained models for each vaccine type and stages of travel are not significantly variant. It implies that the scale can be used for assessing people's concerns about vaccination for international travel irrespective of the stage of the trip or the vaccine being studied.

3.4.1.6. Stage 7- construct and nomological validity. Nomological validity assesses the extent to which a scale measures the specific dimensions it is designed to measure. A second-order structural equation was modeled to determine the construct validity: predictive share of each of the dimensions to the TRAVAC scale. Construct validity assesses the degree to which conceptually defined measurable dimensions gauge the theoretical concept they are theorized to explain (Reich, Beck, & Price, 2018). All the five fit indices showed that the second-order factor structure fitted the data very well, and the dimensions are measuring what they are purported to be studying, and demonstrating the structural validity of the hierarchical CFA (Table 8). This outcome supports modeling vaccination concern as a second-order factor structure. The squared multiple correlations showed that each dimension explained more than 50 percent of the variance in the overall travel vaccination concerns expressed by the respondents (Fig. 3). This suggests that all vaccination concern dimensions significantly matter to travelers.

Table 10
Inter-construct correlation by the square root of the Average Variance Extracted (AVE).

	Efficacy concern		Safety concerns		Cost concern		Time concern		Access concern		Ethical concerns	
	CS	VS	CS	VS	CS	VS	CS	VS	CS	VS	CS	VS
Efficacy concern	0.82	0.79										
Safety concern	0.57**	0.30**	0.72	0.70								
Cost concern	0.31**	0.30**	0.31**	0.38**	0.70	0.81						
Time concern	0.31**	0.45**	0.47**	0.46**	0.31*	0.30**	0.71	0.70				
Access concern	0.21*	0.27**	0.11	0.22**	0.04	0.07	0.19*	0.20**	0.74	0.72		
Autonomy concern	0.11	0.12*	0.08	0.01	0.13	0.12*	0.04	0.06	0.06	0.05	0.70	0.70

Note: CS = calibration sample; VS = validation sample; Values on the diagonal (in bold) represent the square root of the AVEs.

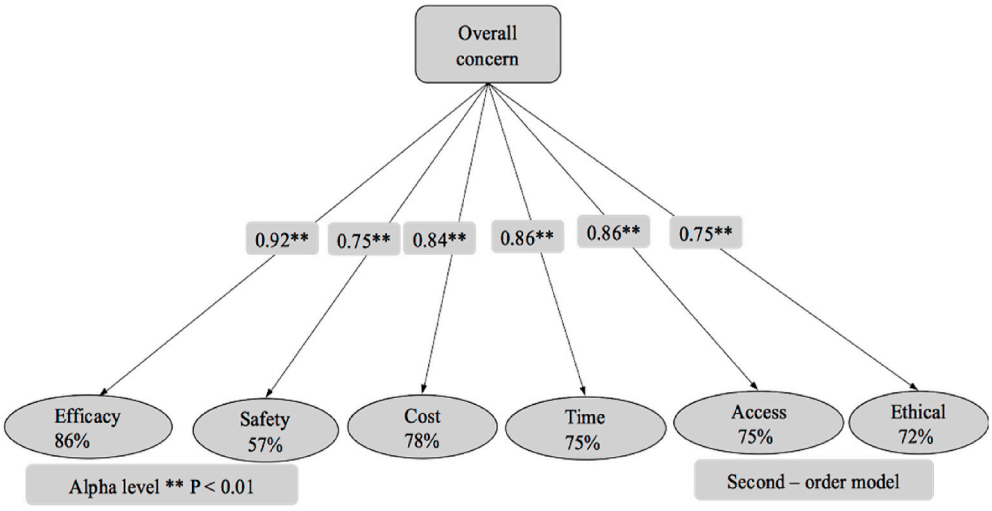

Fig. 3. Second-order CFA model of travel vaccination concerns.

3.4.1.7. Stage 8-Predictive validity of the TRAVAC scale among general tourists. This section analyses the relationship between international tourists' vaccination concerns and their vaccine uptake rate (number of eligible vaccines taken) using data collected from mainstream tourists to Ghana. It is hypothesized that if the scale measures international traveler's vaccination concerns, it would significantly explain their vaccine uptake rate. Predictive validity indicates whether a proposed scale indeed predicts what it intends to.

3.4.1.7.1. Data and analysis. Only respondents eligible for at least a vaccine of the ten vaccines recommended for visitors to Ghana were included in the study (see section 3.3.1.1). The respondents excluded were persons (1) that had pre-existing immunity for the vaccines under consideration as defined by a positive serology, or a history of vaccination or (2) if a health professional considered them immune based on their clinical review or if they had a medical contraindication to the vaccine (Lammert et al., 2016).

The analytical technique used for probing the effect of international tourists' travel vaccination concerns on their vaccine uptake rate was a fractional beta regression since the denominator, the number of vaccines taken is unknown given the differences in eligibility rates. The vaccination uptake rate for each eligible respondent for the current trip/itinerary to Ghana was determined by dividing the number of vaccines taken by the respondent by the number of vaccines he or she is eligible to receive. The fractional regression technique based on its high stability and robustness was chosen over the other alternative methods to estimate the influence of vaccination concerns on uptake rate. The yellow vaccine was excluded from the regression analysis because inbound visitors to Ghana are mandated to take the vaccine, which implies that the reason for its uptake is already known.

3.4.1.7.2. Results and interpretations. Out of the ten vaccines, the average vaccination eligibility rate was 5.47, with those eligible for six (6) vaccines being the majority (18.78). About 17.46 percent of the respondents were eligible to take seven (7) vaccines, followed by those qualified for five (5) vaccines, while those who were not eligible for any of the vaccines were 3.76 percent. In relative terms, Table 11 indicates that the vaccine that most of the respondents were eligible for was the yellow fever vaccine (14.79%), followed by hepatitis B (13.40%), hepatitis A (13.13%), and the least being seasonal influenza vaccine (4.25%). It was quite surprising that some people (about 5%) still visited Ghana without taking the yellow fever vaccine despite it being mandatory. The next highest uptake is among those who were eligible for hepatitis B (86.08%), hepatitis A most under-vaccinated was the seasonal flu vaccine (72.71%). The rabies vaccine placed second (66.52%), followed by polio (48.40%) and typhoid (38.45%) vaccines. Lammert et al. (2016), in a similar study among outbound travelers from

Table 11
Descriptive Statistics for uptake of specific vaccines (N = 452).

Type of vaccine	Relative eligibility		Absolute uptake	
	Eligible respondents (n)	%	Under vaccinated (%)	Fully Vaccinated (%)
Yellow fever	430	14.79	4.97	95.03
Hepatitis A	381	13.13	15.69	84.31
Hepatitis B	389	13.40	13.92	86.08
Rabies	151	5.21	66.52	33.48
Polio	233	8.03	48.40	51.60
Seasonal influenza vaccine	123	4.25	72.71	27.29
Typhoid fever vaccine	278	9.58	38.45	61.55
Meningococcal vaccine	283	9.74	37.46	62.54
DTP vaccine	334	11.49	26.19	73.81
MMR	301	10.37	33.37	66.63

the US, identified the meningococcal and rabies vaccines as two of the three most refused vaccines, aside from the Japanese Encephalitis vaccine.

The TRAVAC scale significantly explained about 28% percent of the variance in the tourists' uptake rate of their eligible vaccines during their trip to Ghana. In contrast, the single-item measure explained only a percent of the variation in their uptake. A unit increase in each of the concerns undermines the uptake rate of travel vaccines. The significant relationships observed among the dimensions of the TRAVAC scale, and vaccine uptake rate confirms the predictive validity of the scale (Table 12). While the other dimensions had a negative relationship with uptake rate, cost concern relates to the uptake rate positively ($\beta = 0.07$; $p < 0.05$). The observation is indicative that cost concern towards travel vaccination does not undermine vaccination rate.

3.4.2. Predictive validity of the TRAVAC scale among a segment-based tourist-study 4

3.4.2.1. Data and analysis. Further validation of the scale involved testing its predictive validity using a different segment of international tourists, backpackers. A distinct population for assessing the predictive validity of scale guards against same population bias and proves the usefulness of the scale across different segments of international travel populations (Adam, Taale, & Adongo, 2020; Churchill, 1979; Reich et al., 2018). A total of 240 backpackers who traveled to Ghana were drawn from the 905 observations in Study 3. Ghana is one of the main backpacker destinations in Africa (Adam, 2015; Dayour et al., 2019). The backpacker sample was filtered using the self-identification approach proxied by the purpose of the visit (Dayour et al., 2019). Respondents were asked in one of the questions which type of visitor one will regard him/herself as with options being 'backpacker' and 'other visitor. 'Backpackers' vaccination hesitancy and uptake of the meningococcal vaccine for their current trip to Ghana served as the outcome variables to test the predictive validity of the TRAVAC scale. Meningitis is one of the diseases Ghana is considered endemic. Besides, the literature has reported high rates of refusal of the meningococcal vaccine among international travelers (Pavli, Katerelos, Smeti, & Maltezou, 2016). Only backpackers who visited Ghana between December and March of the studied period were sampled for the predictive validity analysis. This period is the season that travelers visiting Ghana are vulnerable to meningitis (WHO, 2018).

In this context, hesitancy described individuals' doubts, indecision, and reluctance toward vaccination (Shapiro et al., 2017). It was measured using three items: "I felt reluctant to take the recommended meningococcal vaccine for this trip," "I felt undecided whether to take the meningococcal vaccine for this trip," 'Before I take a particular vaccine I often search for information until I am well convinced of its usefulness" adapted from past studies (Bedford et al., 2017; Larson et al., 2015). The respondents' extent of vaccine hesitancy was measured on a ranking scale of 0–10. Together, the items demonstrated strong uni-dimensionality in principal component analysis with factor loadings ranging from 0.843 to 0.932, and the Cronbach alpha (α) was 0.824. Uptake of the meningococcal vaccine was measured as a dichotomous variable, which is fully vaccinated and under-vaccinated and coded as zero and one, respectively. Only backpackers eligible for the meningococcal vaccine uptake for their current trip were included in the analysis. The same vaccine uptake inclusion and exclusion criteria used for the mainstream travelers in section 3.4.1.6.1 were applied to the backpacker sample. The six dimensions of the TRAVAC scale, on the other hand, served as the predictive variables. Their relationship with backpackers' vaccination hesitancy was estimated using an OLS regression, and with the uptake of meningococcal vaccine using a binary logistic regression. A comparative competing predictive model was assessed using a single-item measure of travel vaccination concern: "Overall, I am concerned about taking travel vaccines" as the explanatory variable.

Table 12
Predictive validity of the TRAVAC scale among general and segment (Backpacker) tourists.

	Eligible Vaccines	Meningococcal vaccine	
	Uptake rate	Hesitancy	Uptake
Concerns	Coef(SE)	Coef(SE)	Odds ratio
Efficacy concern	−0.13(0.04)**	0.35 (0.11)**	0.93(0.10)**
Safety concern	−0.16(0.05)**	0.30(0.14)*	0.92(0.08)**
Cost concern	0.07(0.03)*	0.19(0.05)**	0.99(0.06)**
Time concern	0.06(0.02)*	0.13(0.03)**	0.93(0.05)**
Access concern	−0.56(0.15)**	0.60(0.07)**	0.70(0.04)**
Autonomy concern	−0.03(0.02)	0.13(0.06)*	0.04(0.03)
Constant	3.82(0.37)	0.50(0.05)	0.64(0.02)
R^2	0.28	0.17	0.13

Robust standard errors are in parenthesis **p < 0.01, *p < 0.05.

3.4.2.2. Results. The results (Table 12) showed that all dimensions of the scale together explained about 13 percent of the variance in backpackers' uptake of the meningococcal vaccine, whereas the single-item measure explained only 1 percent (odds = 0.91; $p > 0.05$) of the variance in their uptake. The dimensions also explained 17 percent of the variation in backpackers' hesitancy towards travel vaccination while the single item explained two percent. The significant relationships observed among the dimensions of the scale and between the dependent variables broadens and stresses the nomological and predictive validity of the TRAVAC scale. The outcome implies that the scale is a better predictor of vaccine uptake, whether measured as an attitude or behavior and across different international travel populations.

All the six concern dimensions have a significant positive relationship with the backpackers' vaccine uptake attitude (hesitancy) and a negative association with their uptake of the meningococcal vaccine except for autonomy concerns. The results mean that most of the dimensions of the TRAVAC scale stimulate under-vaccination and should not be taken for granted.

4. Discussion

Immunization against infectious diseases is one of the surest ways overseas travelers can safeguard themselves against these diseases abroad. However, people remain concerned about various aspects of vaccination. With the current research, we aimed to offer the community of travel medicine researchers and practitioners a standardized psychometric scale that would enable them to assess travel vaccination concerns reliably and objectively. The four studies conducted converge with evidence of a six-dimensional scale. The dimensions are safety, efficacy, cost, time, access, and autonomy concerns.

While the remaining four dimensions of the scale are conceptually unique, the facets of the safety and efficacy dimensions share some commonalities with the measurement items of some of the general vaccination concern related scales. These scales include the (1) 'harm' and 'trust' dimensions of the three-factor vaccination confidence scale (Gilkey et al., 2014), (2) the one-dimensional, vaccine conspiracy beliefs scale (Shapiro et al., 2018) and (4) 'mistrust' and 'worries about unforeseen future effects' 'preference for natural immunity' dimensions of the four-factor vaccination attitudes examination scale by Martin and Petrie (2017). Despite the similar constructs, the measure items of these two dimensions of the TRAVAC scale are travel-context specific. Beyond these dimensional differences and similarities highlighted between the general vaccination-concern related scales and the TRAVAC scale, the determinants of these intersections and uniqueness of the current scale are discussed in the ensuing paragraphs.

Questioning vaccine efficacy and safety are the most common concerns in the literature, although protective efficacy lapses are shown to be few (Karafillakis & Larson, 2017; Steffen & Connor, 2005). These concerns are indications of the uncertainty of the impact of vaccinations

on one's health when abroad. This uncertainty has been partly attributed to the development of new medical technologies, including vaccines, which outpace the provision of evidence regarding their benefits and harms (Hillen et al., 2017). Other safety and efficacy concerns result from mistrust about vaccines and related institutions, historical conspiracies, and misconceptions about immunization, fueled by religious orientations, political, economic, and cultural issues (Grabenstein, 2013; Yaqub et al., 2014).

However, in the context of international tourism, the literature currently provides no explanation for vaccine safety and efficacy sentiments by travelers. We postulate that two main factors could account for those concerns. The first is a spillover of vaccine safety sentiments in everyday life into travel context though the travel context informs the current feelings. Studies have noted some intersections between tourists' attitudes and behaviors on vacation with "their quotidian habits of daily experiences" (Sthapit & Bj&rk, 2017, p. 210). The reasons for possible spillover of vaccine safety and efficacy concerns into travel context. This is because of availability heuristics and psychological commitment—the tendency to draw on information quickly, most likely adverse events, available in one's mind, which, in turn, forms the basis of evaluating an event when asked to do so (Tversky & Kahneman, 1973). The salient point in availability heuristics is that if an issue is easily recalled, it is an indication of its importance to the individual. The second, but the remote, reason is international tourism's characterization—a movement away from one's home, across national and international boundaries, over some time. The distance between 'home' and 'away' coupled with the conviction that events are less risky at home than abroad, home-is-safer-than-abroad bias, may provide reasons for tourists' to be concerned about the safety of vaccinating in a few days before traveling abroad. This would especially be true if an individual is already leery of travel vaccinations or perceives less or no control over adverse events following immunization.

Travelers are advised by the WHO to consult their GMs four to six weeks before departure to receive necessary vaccines. Vaccinating within schedule ensures adequate immunity against travel-associated VPDs. The majority of travelers obey the early uptake of vaccine directive by the WHO and are unlikely to experience adverse effects of vaccination during the trip. But, a few them do not as they consult on the day of departure or a day before and are likely to express fear of side effects while abroad (Boubaker et al., 2016). If those tourists who vaccinate within the recommended schedules are part of those who express side-effects sentiments, those feelings might be uninformed fear given that they are highly unlikely to experience adverse effects during the actual trip.

The third and fourth dimensions of the TRAVAC scale are time and cost concerns. Both concerns are associated with a perceived loss of time convenience and monetary cost in accessing travel vaccines. Time and cost concerns from the supply-side are linked to vaccination services and on the demand-side, unaffordability. Unaffordability denotes the inability of travelers to access vaccination, both in terms of financial and non-financial costs due to due to resource scarcity (Thomson et al., 2016). When people are resource constrained, they become overly focused on the resource and conscious about the cost to acquire goods and services, which make them feel cognitively taxed (Hamilton, Mittal, Shah, Thompson, & Griskevicius, 2019).

Every consumer has a reservation price, which is the maximum amount that he or she is willing and ready to pay for a product or service. Any market price above this price is likely to be met with resentment. Broadly, a multiplicity of factors may account for the cost concerns associated with travel vaccination. The primary reason is that most travel vaccines are currently not covered by routine vaccination programs and care plans, denoting that the individual has to bear the full fee associated with each vaccination (Steffen & Connor, 2005). Routine vaccines are most often part of national immunization programs and thus benefit from subsidies of governments and other funding agencies (Crockett & Keystone, 2005). A web search shows that travel vaccines can cost as much $195USD for Yellow Fever, $300 for Cholera, $339 for Human Papilloma Virus (HPV), $350 per injection of Japanese Encephalitis (two doses series required),[https://www.kelsey-seybold.com/medical-services-and-specialties/travel-clinic/price-list]. Other sources of vaccination cost include transport to travel clinics and administrative services (Favin, Steinglass, Fields, Banerjee, & Sawhney, 2012). Cost may disproportionately impact backpackers' uptake of vaccination than other international travelers because of some reasons. Backpackers are often financially constrained because (1) most of them are gap-year students and unemployed (Dayour, Adongo, & Taale, 2016); (2) they travel to multiple destinations, which increase the range of vaccines needed, and (3) they travel to destinations with diseases that are expensive to vaccinate.

The amount of time spent accessing travel vaccines may equally depend on a multiplicity of factors such as distance to a clinic, waiting time in consultation, and type of vaccine involved (Favin et al., 2012). For instance, it may sometimes require extra time for travel health practitioners to educate patients about the safety, efficacy, and usefulness of vaccines before administration, which has implications on time convenience. Though tourism is a discretionary time and income activity, time and cost considerations could, mainly, be essential factors to tourists at the trip planning stage as they strive to plan different and complicated things (Wang, Zhou, Leesa, & Mantwill, 2018). Besides vaccinations, the available time and income resources are competed for by other activities such as planning for flights and accommodation. Any event that has the potential to limit the optimal use of these resources, depending on priorities, would raise concerns. The finding on cost and time concerns could indicate that tourists' do not significantly allocate their disposable time and income to vaccination relative to other components (such as airfares) — crowding out effect during trip planning. Previous studies (including Dolnicar, 2008) in different travel settings shave noted competing relationships among discretionary income and time expenditure.

The fifth dimension, access concern, denotes individuals' inability to find necessary vaccines and/or information relating to vaccination. This concern suggests essential awareness among tourists that vaccines are needed when they are traveling abroad only that they are unable to access them. In the context of travel vaccination, this finding provides an answer to Lydon et al. 's (2017) question that "are essential vaccines always available when needed? Further, the finding reinforces that access to vaccines remains a significant constraint to immunization among international travelers, an observation supported by previous studies (Lammert et al., 2016; Lydon et al., 2017). For example, the latter research notes that vaccine stock out remains a pervasive challenge at national and sub-national levels and is attributable to government funding delays, delays in procurement processes, poor forecasting, and stock management. The policy concerns with the unreliable supply of vaccines are that it can directly or indirectly heighten cost and time concerns risking under-vaccinations. In another breadth, we infer that the concern about the unavailability of vaccines and related information signals their admittance of the need for vaccination, the extent of their search effort to acquire recommended vaccines, and their readiness to adopt vaccines made available.

The last dimension, which is autonomy concern, has to do with the feeling that some travel vaccination policies are depriving of one's health-seeking freedom. Autonomy in healthcare is a long-standing issue but more palpable today, maybe because of the revolution of patient-centered medicine, which calls for provider-patient active co-creation of health and freedom of choice for the patient (Elg, Engstr&m, Witell, & Poksinska, 2012). This freedom has become a central part of an individual's health decisions with any potential inhibitions to this freedom likely to face resistance. Some of the respondents claimed that international travel is a conduit that "immunization social order" — institutions, laws, pharmaceuticals biotechnologies, and social practices" (Kirkland, 2016b) use to impose certain vaccines on people. These sentiments somewhat reflect Kirkland's (Kirkland, 2016b) view of rising

'vaccine social activism and critical movements' against vaccination. The finding of sub-optimal vaccination decisions among the travelers concerned about vaccine mandates corroborates Attwell and Smith's (2017) argument. They argue that though mandates may be useful in guiding and constraining individual's vaccination decisions for communal welfare, they can generate lousy publicity leading to hesitancy and refusals of vaccines that are non-mandatory. Even though only a few vaccines are required during travel, travelers who are concerned about vaccine mandates may refuse recommended vaccines to signify their displeasure against the mandates. Such opposition may be legitimate, but in principle, mandates are appropriate where there are potentials of hesitancy and suboptimal decisions, which result in collective effects. The choice to accept a particular vaccine or not is an individual decision, but the underlying consequences linked to the decision is a common issue (Kasperbauer, 2017).

5. Conclusions and implications

5.1. Theoretical conclusions and implications

A comprehensive scale for measuring travelers' concerns about vaccination for international travel, which hitherto was not available in the travel medicine literature, is proposed. Six main concerns: safety, efficacy, cost, time, access, and autonomy, are revealed which manifest in the form of perceived risks and uncertainties, worry, anxiety and fear about vaccination outcomes, access constraints, and ethics/morality about vaccination mandates. The finding confirms a prior expectation that travelers' vaccination concerns are multi-dimensional in nature, which are either cognitive, emotional, or combined and should be studied as such. The proposed scale represents a significant contribution to the literature regarding the conceptualization of travel vaccination concerns, its theoretical bounds, and specific dimensions as a psychometric concept. The all-encompassing nature of the TRAVAC scale is advantageous for tailored-studies because of the availability of different vaccines for different travel-related diseases, each of which could evoke specific concerns. Such extensiveness of the scale makes it more theoretically relevant for ascertaining travel vaccination concerns and identifying their antecedents, moderators and implications for uptake irrespective of the type of vaccine and tourist studied.

Methodologically, we further argue and conclude that the measure for international travel vaccination concerns is unique in character and construction, given that their travel-space informed their vaccination sentiments. This conclusion suggests that though some measures of anti-travel vax sentiments and public vax sentiments, such as safety and efficacy, maybe conceptually intersecting, they are distinct and should not be used as proxies without careful adaptation.

The TRAVAC scale reliably predicts the vaccine uptake rate and uptake of specific vaccines among mainstream and specific tourists' segments though variation is observed in the impact of the cost dimension. The prediction implies that heightening concerns towards vaccination for travel is associated with an increased likelihood of under-vaccination. This reinforces earlier conclusions that concerns significantly predict attitudes and behavior, such as hesitancy and refusal, toward travel vaccination. Therefore, the TRAVAC scale could be used as an efficient and effective measure for identifying vaccination resistors and their underlying concerns.

5.2. Management implications

The study's findings have relevance for travel medicine and public health practitioners on several issues regarding vaccination for travel. These include surveillance of concerns, pre-travel counseling programs, care and access plans, wait-time management strategies and vaccine formulation. The TRAVAC scale not only calls for the need but represents a comprehensive quick assessment tool for clinicians in assessing and resolving concerns about vaccination for travel. Given that commonalities exist in some of the dimensions of anti-travel sentiments and general vaccine sentiments, two practical lessons are learned. First, it signals that the scale is adaptable for identifying the concerns that people (both public and travel populations) have about vaccines and, by extension, the reasons underlying their vaccination hesitancy and refusal. The comprehensiveness of the scale and its significant explanatory ability for vaccine uptake attitudes and behavior make it more clinically relevant for different travelers and vaccines. Second, strategies for resolving the concerns identified by the TRAVAC scale should be broad in scope and cover the six-dimensions, which could potentially be useful for both the general public and international travelers to engender pro-vaccination behavior. The varied nature of the concerns also suggests the need to develop a travel vaccination sentiments tracker. The WHO needs to institutionalize a dedicated smart system, potentially similar to the Vaccine Sentimeter, for continuous surveillance of travelers' vaccination concerns for swift resolution given that attitudes change with time. The TRAVAC scale can be a useful, handy, and comprehensive foundational framework for structuring this intelligent system.

The fact that concerns undermine the vaccine uptake rate among international travel populations further holds management implications and requires innovative schemes to help resolve the specific concerns identified. GMs should institute tailored educational counseling during pre-travel consultations. The provision of evidence, accessible, and transparent travel-based information on vaccine risk and benefits could be useful in minimizing the vaccination safety and efficacy concerns, which manifested in the form of misconceptions, falsehoods, and myths. Instead of countering the sentiments by myth-busting measures, these concerns need to be surrounded with the appropriate information, in support of vaccination. Ubiquitous web channels, including clinic's official websites or government consulates and the CDC, could be leveraged for mass campaigns. Understanding how tourists use social media platforms such as TripAdvisor and capitalizing on their ubiquity could be useful in listening to and tactically resolving concerns.

Cost concern is positively related to vaccine uptake, which denotes that cost is not necessarily a significant disincentive to vaccine uptake among the majority of travelers. However, it does for some specific segment-based travelers like backpackers. It is reasoned that perhaps among the majority of international travelers, the perceived benefits of immunization outweigh the monetary cost of vaccines. The provision of information by travel medicine stakeholders that enables international travelers to appreciate the importance of vaccinations could compensate for their perceived financial loss and stimulate uptake. Because of the role that individuals or clusters who refuse vaccines play in disease outbreaks, other measures should be taken to tackle the identified cost concerns directly, especially for those who travel on limited budgets. Stakeholders, such as the WHO, Global Alliance for Vaccines and Immunization (Gavi) and governments, in their health care plans could introduce financial incentive measures to make vaccines more affordable and accessible to international travelers. Travel vaccines can be offered for free or at discounted rates. Though some sporadic studies have pointed out the potential crowding-out effects of incentives, evidence indicates that compliance and coverage increase when vaccines are offered at discounted prices (Blank, Schwenkglenks, & Szucs, 2012).

Discounted vaccination could contribute towards bridging income inequality as a determinant of immunization among tourists because they are often faced with budgetary constraints. Backpackers, in particular, are always looking for ways to manage their travel budgets, and hence having a reduced cost of medicine can be handy. If tourism is seen as a public good or human right, and under-vaccination is a hazard to the general public's health and well-being, travelers should be motivated to take vaccines by making them affordable. Besides, travelers are strongly advised and encouraged to take up insurance schemes that cover most or all travel vaccines. Insurance covers indeed reduce the cost concerns of travel vaccination when compared to out-of-pocket payment. Tourists could also adopt advanced pre-holiday vaccination

research and discount/subsidies-hunting methods. Aside from budgets for flights, the UNWTO, travel agencies, and destination management organizations (DMOs) should educate tourists for them to think of their health first and the obligation to consider travel vaccination as one of the components of their travel budgets. The international travelers' perceived time loss in accessing vaccination services provides opportunities for recasting the re(design) of clinical situations, service processes, and vaccine formulation. Pearce (2020:6) notes that "despite the best planning efforts of tourists and those who provide services for them, there are often passages of time where people have to wait or occupy themselves before the resource they seek is accessed." Pearce (2020) recommends wait-time management imperatives of specifying duration, managing and filling downtime, and encouraging engagement. These strategies can be employed by clinics to manage travelers' frustrations about it being time-wasting to access travel vaccines. Pre-informing them of the waiting period of the vaccination process, scheduling appointments, encouraging wait-time empathy, and leveraging destructive entertaining activities during the waiting period could be useful.

This study supports the call for pharmaceutical companies and biomedical engineers to introduce smart, needle-free injection devices as well as reduce dose regimens into single-administration vaccines without compromising efficacy. This helps to reduce the fear and anxiety associated with vaccines given by injections, shorten administration time, reduce the cost of travel vaccinations and improve patient adherence as fewer shots and visits would be required to provide immunity (McHugh, Guarecuco, Langer, & Jaklenec, 2015; Taberner, Hogan, & Hunter, 2012). The smart needles are also beneficial from a healthcare expenditure and financial sustainability perspective as patients would have to pay for fewer travel clinical visits as it would be for low upfront financial investments by governments and insurance companies (McHugh et al., 2015).

Access concerns, which manifest in the form of ignorance of needed vaccines and lack of reliable information on which travel clinics to find all required vaccines, can be resolved by instituting a smart vaccine finder and advisory system, which directs them to the appropriate places. Tourism service providers such as airlines, trip advisor, Airbnb, and travel bloggers in collaboration with WHO, CDC, and travel clinics could post the vaccine finder pop-up, such as that of the HealthMap Vaccine Finder by WHO, for those who are searching for information on travel vaccination. This service would enable travelers to explore and identify clinics that stock all needed vaccines and compare prices for best deals. By implication, this would help reduce immunization fees, not to mention the time convenience. More importantly, the WHO, Gavi, pharmaceutical companies, and travel clinics should ensure that travel vaccines are readily available and accessible. This can be done by improving the forecasting accuracy of vaccines' demand and supply to minimize stockouts or, at best, eliminate them (Lydon et al., 2017). DMOs through their travel booking data could help these agencies plan their stocks by signaling how many travelers from each originating country are likely to be vaccinating and for which diseases. However, further studies are required to verify the stockout experiences from the perspective of the vaccine service providers since the reality may be different. Finally, it is recommended that vaccine mandates be supplemented by broader efforts to increase public trust and support for vaccines while seeking a balance between rights and public safety.

6. Limitation and directions for future research

The current study is an exploratory attempt to propose a measurement scale for gauging international tourists' travel vaccination concerns. However, some limitations are worth acknowledging and should motivate future research into these issues. Though the study took into consideration matters toward a wide range of specific travel vaccines, its attempt to propose a generic scale for gauging travel vaccination concerns could be an over universalization of the reality. Further vaccine-specific studies are required to validate various aspects of the scale, given that perceptions and attitudes vary significantly with different vaccines and respondents' characteristics. Future research could also explore the utility of the scale among different typologies of tourists, such as volunteer tourists or other travel groups, including business travelers, pilgrims, and migrants in other destination settings. This will help further insights into the antecedents of the TRAVAC scale and especially how the scale relates to group normative. The scale could also be investigated in other hierarchical forms while seeking to identify its moderators (i.e., travel experience, information exposure, and vaccination literacy) and outcomes. Exploring how the scale plays out during this COVID-19 period, especially its implication for the uptake of a potential COVID-19 vaccine among travelers, would be another exciting avenue of research.

It is essential to note that some respondents were recruited into the study while they were traveling. Moreover, while some of them had received some vaccines, others had not at all. Since people have reasons for the decisions they take, those who had received some vaccines before traveling were likely to lower their concerns compared to those who did not receive any vaccine. Travel blogs, TripAdvisor, and similar sites, from which some qualitative data were drawn for the study, might contain inflated sentiments, which could have undermined the credibility of the data. However, we think that this is less likely to compromise the usefulness of the findings because of the rigorous nature of our research methodology and the fact that personal concerns, no matter how minute or exaggerated they are, have noteworthy negative implications for the uptake of vaccines. Future research into the competing alternatives to travel vaccination time and income spending and the extent of competition could provide insights into potential cross-sectoral integration of travel vaccination services.

Declaration of competing interest

The authors declare that we have no known competing financial interests or personal relationships that could have appeared to influence the findings reported in this paper.

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Appendix A. Summaries of the study population, size and scope

Type of sample	International travel population	Data collection method	Size	Scope
Item generation sample	General travelers	Scoping review	86	Global
	General travelers (predominantly tourists and pilgrims)	Data mining	1235	Global
	Inbound tourist	Field interviews	20	Ghana

(continued on next page)

(*continued*)

Type of sample	International travel population	Data collection method	Size	Scope
Exploratory sample	General inbound tourist	Survey	250	Ghana
Validation sample (Convergent and discriminant validity)			905	
	General inbound tourist	Survey	452	Ghana
	General inbound tourist	Survey	453	Online
Nomological and predictive validity sample	General Tourist to Ghana	Survey	452	Ghana
	Inbound Backpackers drawn from the validation sample	Survey	240	Ghana

Note: Data collection spanned between July 2016–March 2019

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tourman.2020.104180.

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